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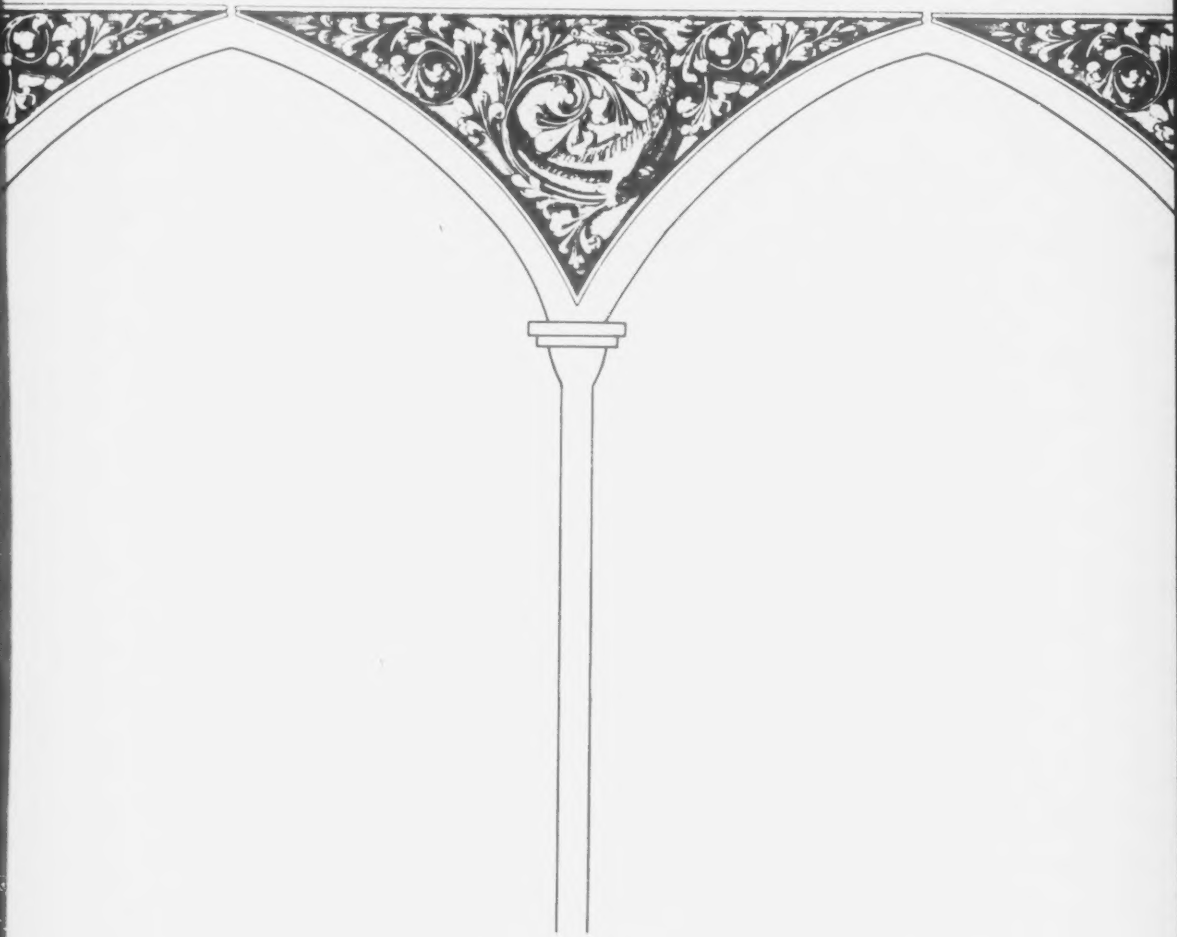
Technologies for Prehistoric & Historic Preservation



Summary

CONGRESS OF THE UNITED STATES
Office of Technology Assessment
Washington, D.C. 20510

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The Technology Assessment Board approves the release of this report. The views expressed in this report are not necessarily those of the Board, OTA Advisory Council, or individual members thereof.

Foreword

Archaeological remains and historic structures and landscapes are important tangible reminders of this Nation's rich and diverse cultural heritage. They provide a sense of our past and contribute in other ways to our quality of life. Yet, in recent years, as the result primarily of population shifts, urban growth, and energy development, the stresses on these unique, nonrenewable cultural resources have increased dramatically. As this assessment makes clear, the appropriate use of a wide variety of preservation technologies, many of which were originally developed for applications in natural science and engineering, could reduce many of these stresses.

This summary presents the primary findings of an assessment requested by the House Committee on Interior and Insular Affairs. The Subcommittee on Public Lands is carrying out a major review of how Federal agencies implement Federal preservation policy. This assessment directly supports the Committee's review by showing how the uses of certain methods, techniques, as well as tools and equipment can assist Federal, State, and local preservation efforts.

The assessment takes the unusual step of focusing on the applications of preservation technologies rather than preservation disciplines. It examines the current use of preservation technologies and identifies research and development needs. It also explores how improvements in Federal policy and implementation can facilitate the more effective use of technologies appropriate for managing this country's prehistoric and historic cultural resources.

In undertaking this assessment, OTA sought the contributions of a wide spectrum of knowledgeable and interested individuals. Some provided information and guidance, others reviewed drafts of the report. OTA gratefully acknowledges their contributions of time and intellectual effort. OTA also appreciates the timely help rendered by a number of individuals from the National Park Service.

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NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by the review panel and workshop participants. The panel and workshops do not, however, necessarily approve, disapprove, or endorse this report. OTA assumes full responsibility for the report and the accuracy of its contents.

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Technologies for Prehistoric and Historic Preservation

INTRODUCTION

The preservation of this country's prehistoric and historic heritage has a long tradition of community support and academic and political interest. Federal preservation legislation, commencing in 1906,[1] reflects the national value and significance that U.S. prehistoric and historic cultural resources possess, whether managed by Federal, State, or local governments or private citizens. As the *National Historic Preservation Act* asserts,

> . . . the preservation of this irreplaceable heritage is in the public interest so that its vital legacy of cultural, educational, aesthetic, inspirational, economic, and energy benefits will be maintained and enriched for future generations of Americans.[2]

Virtually every congressional district contains federally managed sites, structures, or landscapes of prehistoric and historic interest.[3] The ability of Federal agencies to carry out their preservation responsibilities, within the context of managing public lands[4] and other duties, rests increasingly on discovering and using cost-effective techniques, methods, and equipment for studying and protecting these important cultural resources.

This assessment was requested by the House Committee on Interior and Insular Affairs to assist the committee's legislative authorization and oversight of Federal preservation efforts. During 1986, the 20th anniversary of passage of the *National Historic Preservation Act*, the Subcommittee on Public Lands initiated a major review of how Federal agencies implement the provisions of laws relating to prehistoric and historic properties (table 1). The findings of this assessment support the subcommittee's efforts to review how the use of technologies, including methods and techniques, as well as tools and equipment, can assist historic preservation.

As the population of this country has grown and urban centers have become more dense and expanded into the countryside, the stresses on cultural resources have increased dramatically. The destruction of shipwrecks and submerged archaeological sites, particularly along the coasts of Texas and Florida, has also increased significantly in recent years. Currently, the

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[1] *The Antiquities Act of 1906* (Public Law 59-209).

[2] National Historic Preservation Act (Public Law 89-665), Sec. 1(b) (Purpose of the Act), para. 4.

[3] See, for example, the National Register of Historic Places, which lists significant prehistoric and historic places throughout the United States.

[4] For example, the Federal Land Policy and Management Act of 1976, Sec. 102(a)(8), calls for "the public lands [to] be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental. air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use."

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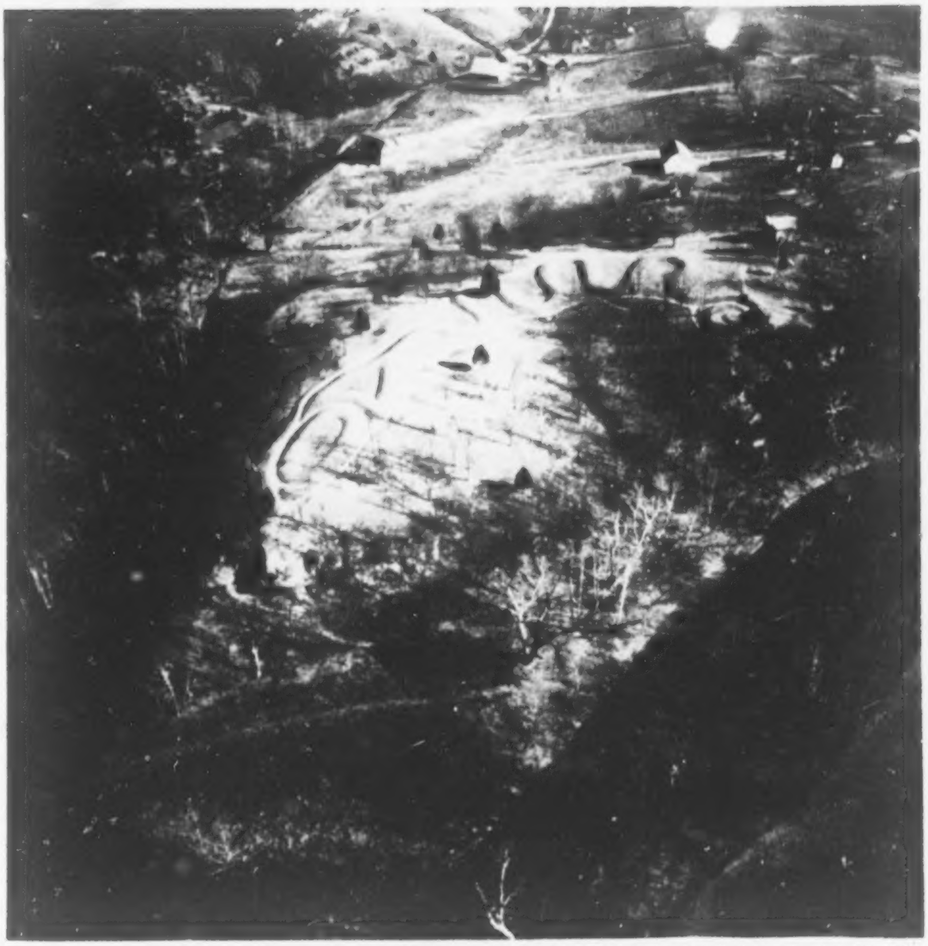

Photo credit: (Aerial photo by Dache M. Reeves, Jan. 20, 1934. Courtesy of Smithsonian Institution National Anthropological Archives).

Serpent Mound in modern farm landscape, south-central Ohio. Designed and built by the so-called Adena culture, which flourished in the first millenium B.C., this is an unusual example of thousands of earthworks found throughout the Central and Southeastern United States.

Table 1.—Prehistoric and Historic Preservation Laws and Executive Orders

Laws:
- The Antiquities Act of 1906, Public Law 59-209 (6 U.S.C. 431-433)
- The National Park Service Organic Act (An Act of Aug. 25, 1916), (39 Stat. 535, 16 U.S.C. 1)
- The Historic Sites Act of 1935, Public Law 74-292 (16 U.S.C. 461-467)
- The National Historic Preservation Trust Act of 1949, Public Law 81-408 (63 Stat. 927, 16 U.S.C. 468 et seq.)
- The Submerged Lands Act of 1953, Public Law 83-31 (67 Stat 29, 43 U.S.C. 1301 et seq.)
- Outer Continental Shelf Lands Act, Public Law 83-212 (67 Stat. 462, 43 U.S.C. 1331 et seq.)
- The Management of Museum Properties Act of 1955, Public Law 84-69 (16 U.S.C. 18f)
- The Reservoir Salvage Act of 1960, Public Law 86-523 (16 U.S.C. 469-469c)
- The Department of Transportation Act of 1966, Public Law 89-670 (80 Stat. 931)
- The National Historic Preservation Act of 1966, Public Law 89-665 (16 U.S.C. 470)
- The National Environmental Policy Act of 1969, Public Law 90-190 (16 U.S.C. 470)
- Executive Order 11593, ''Protection and Enhancement of the Cultural Environment,'' May 13, 1971. (36 F.R. 8921)
- Alaska Native Claims Settlement Act, Public Law 92-203 (85 Stat. 688, 43 U.S.C. 1601-1624)
- The Archaeological and Historical Preservation Act of 1974, Public Law 93-291 (88 Stat. 174, 16 U.S.C. 469 et seq.)
- American Folklife Preservation Act of 1976, Public Law 94-201 (20 U.S.C. 2101-2107)
- The American Indian Religious Freedom Act of 1978, Public Law 95-341 (92 Stat. 46a, 42 U.S.C. 1996)
- Central Idaho Wilderness Act of 1980, Public Law 96-312 (94 Stat. 948, 16 U.S.C. 1274)
- National Historic Preservation Act Amendments of 1980, Public Law 96-515 (94 Stat. 2987, 16 U.S.C. 470 et seq.)
- The Archaeological Resources Protection Act of 1979, Public Law 96-95 (16 U.S.C. 470aa et seq.)
- Convention on Cultural Property Implementation Act, Public Law 97-466 (96 Stat. 2350-2363, 19 U.S.C. 2601-2613)

Legislation under consideration in the 99th Congress:
- R.M.S. TITANIC Memorial Act of 1985 (H.R. 3272)
- The Abandoned Shipwreck Act of 1985 (H.R. 3558 and S. 2569)
- The Olmsted Heritage Landscapes Act of 1985 (H.R. 37)

Regulations:[a]
- 43 CFR 3 (Antiquities Act)
- 43 CFR 7 (Archeological Resources Protection Act of 1979)
- 36 CFR 60 (National Historic Preservation Act of 1966 (NHPA) and EO 11593)
- 36 CFR 61 (NHPA and EO 11593)
- 36 CFR 63 (NHPA and EO 11593)
- 36 CFR 65 (Historic Sites Act of 1935)
- 36 CFR 66 (Archaeolgical and Historic Preservation Act of 1974)
- 36 CFR 68 (NHPA)
- 36 CFR 800 (NHPA and EO 11593)
- 40 CFR 1500 (NEPA) ''Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.''

Standards and Guidelines for Historic Preservation:

''The Secretary of the Interior's **Standards for Rehabilitation** and Guidelines for Rehabilitating Historic Buildings,'' National Park Service (revised 1983), booklet.

''The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation,'' *Federal Register* 48, No. 190, Thursday, Sept. 29, 1983.

''Final Uniform Regulations, Archaeological Resources Protection Act of 1979,'' *Federal Register* 49, No. 4, Friday, Jan. 6, 1984.

''Draft Guidelines for Historic and Archeological Resource Management: Federal Agency Responsibilities Under Section 110 of the National Historic Preservation Act,'' National Park Service, Feb. 5, 1986.

Advisory Council on Historic Preservation, Executive Director's ''Procedures for Review of Proposals for Treatment of Archaeological Properties: Supplementary Guidance,'' 45 *Federal Register* 78808.

Advisory Council on Historic Preservation ''Protection of Historic Properties,'' 36 CFR Part 800, *Federal Register* 51, No. 169, Sept. 2, 1986.

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[a] Regulations are promulgated, adopted, and then compiled in the Code of Federal Regulations (CFR), in order to implement provisions of general laws. The name of the act it implements follows each citation.

SOURCE: U.S. Department of the Interior and Office of Technology Assessment.

United States is losing its prehistoric and historic cultural resources at an alarming rate[5] in spite of the best efforts of preservation professionals to identify and protect them. Because the national inventory of these cultural resources is far from complete, sites, structures, and landscapes that may have prehistoric or historic significance may not be cataloged and protected before they have been destroyed or dramatically altered.

This assessment provides an overview of technologies relating to the care and preservation of cultural resources. In this assessment, **preservation technology refers broadly to any equipment, methods, and techniques that can be applied to the discovery; analysis; interpretation; restoration; conservation; protection; and management of prehistoric and historic sites, structures, and landscapes.** The assessment also examines a variety of options related to the use of preservation technologies and suggests improvements in implementing current policy. It does not address

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[5] For example, experts estimate that fewer than 10 percent of the prehistoric Mimbres sites in southwestern New Mexico are free from damage due to looting and vandalism. See Carol Ann Bassett, "The Culture Thieves," *Science*, July/August 1986, p. 22. In addition, see the extensive discussion in Leslie E. Wildesen, "The Study of Impacts on Archaeological Sites," *Advances In Archaeological Method and Theory* 5, 1982, pp. 51-96.

FERRYBANK RESTAURANT
TAVERN UNDER THE BRIDGE
ONE WAY

Photo credit: HABS/HARE, National Park Service

Brooklyn Bridge seen from Front Steet.

the preservation of paintings, books, and other artifacts; however, some technologies used for their preservation are also applicable to sites, structures, and landscapes.

In the course of this assessment, OTA held a series of five workshops that explored the range of issues raised by the application of technologies to prehistoric and historic preservation:

1. Technologies for the Preservation of Archaeological Sites and Structures,
2. Technologies for the Preservation of Historic Structures,
3. Technologies for Underwater Archaeology and Maritime Preservation,
4. Technologies for the Preservation of Planned Landscapes and Other Outdoor Sites, and
5. Technologies for the Physical Protection of Prehistoric and Historic Sites.

More than 100 individuals participated in the workshops, either as invited participants or as observers.

CONTEXT

The U.S. historic preservation movement has always enjoyed broad public support. It began even before Federal preservation legislation with grassroots efforts to restore and conserve the houses, monuments, and battlefields related to the history of the United States, focusing on the protection of sites and structures connected with the "great men" of U.S. history. Over time, that focus has broadened to include an exploration of the tangible and intangible remains of a more culturally heterogeneous past that includes such diverse resources as Native American sites and structures, historic vernacular buildings and landscapes, and submerged sites and shipwrecks.

This change in emphasis necessitates interdisciplinary approaches to the management and preservation of sites, structures, and landscapes. **Different stages of the preservation process may now require the involvement of specialists from such divergent fields as anthropology, archaeology, architecture, chemistry, folklore, geology, history, landscape architecture, oceanography, and planning and engineering.**

MAJOR FINDINGS

The boundaries separating the practice of archaeology and the preservation of historic structures and historic landscapes are becoming increasingly indistinct. Preservation professionals apply many of the same technologies to the study and conservation of sites, structures, and landscapes. In addition, **preservationists in all the associated disciplines share problems of obtaining access to information about technologies, training, and coordinating research.** Finally, they share the constraints of inconsistent funding and a serious lack of coordinated implementation of Federal policy.

New technologies can extend the scope of our understanding and care of the U.S. cultural heritage by improving the quality, quantity, type, and usefulness of data gathered. Certain technologies can also improve the authenticity of restoration, and the effectiveness of conservation and maintenance. Yet, **a variety of educational, institutional, managerial, and cost barriers inhibit the broad application of new methods, techniques, and equipment to preservation.**

In many cases, the technologies appropriate to prehistoric and historic preservation have been developed for use in natural science and engineering disciplines, but have not been adequately adapted to preservation requirements. The efficient transfer of technology developed in other disciplines to preservation is impeded by preservation specialists' frequent lack of familiarity with natural science and engineering. It is also slowed by a general lack of formalized interdisciplinary approaches to preservation problems. Similarly, many natural scientists and engineers are unfamiliar with the needs and goals of preservation, yet many would be receptive to assisting the preservation community in applying new technologies.

If advanced technologies are to assume a greater role in preservation, it is important to find more effective means of transferring technology developed in other fields to prehistoric and historic preservation. These will include:

- training in the use of technologies,
- studying ways to apply known technologies to preservation problems,
- improving information-sharing and coordination,
- finding the appropriate fit of technologies to preservation problems,
- reducing costs of new technologies, and
- developing standards for the application of new technologies.

Improved transfer of technology will also require greater acceptance among preservation specialists of the role technologies play in solving cultural resource problems. It will also require more effective training in the management of cultural resources.

Other countries, particularly in Europe, have been applying technologies to preservation longer than the United States. In part this stems from their longer histories as nations. In part, it is the result of stronger and better coordinated national support for preservation from their Ministries of Culture.

In some cases foreign technologies may represent significant advances over U.S. practices. For example, German methods for recording historic structures are far more complete and result in more detailed drawings and data than U.S. methods. Archaeologists in the United Kingdom employ advanced methods of physics and chemistry in analyzing artifacts more readily than many U.S. archaeologists. European art historians also use more advanced techniques to preserve their prehistoric rock paintings and carvings. European techniques of preserving submerged wooden ships and other maritime artifacts have led U.S. efforts. The French have developed a sophisticated airborne infrared scanner for investigating landscapes, as well as advanced methods for using it effectively. **Foreign experiences with preservation techniques, methods, and equipment should be examined closely for possible transfer to U.S. applications.** The United States would also benefit by increased cooperation with other nations in developing and testing new preservation methods. It could strengthen channels of communication between the United States and other countries by reinforcing its participation in the International Council on Monuments and Sites (ICOMOS).

The preservation of the U.S. cultural heritage often results in economic benefits (such as jobs and increased tourism) to individuals and communities. In order to convince decisionmakers of the value of retaining the best or most significant historic structures and landscapes, preservationists must better quantify and measure the economic benefits of restoring and rehabilitating them. They must also articulate more effectively the benefits related to quality of life. For example, rehabilitating a historic structure may be cheaper than replacing it with a modern one. In addition, the intangible benefit of retaining a sense of belonging and place by retaining the historic integrity of a neighborhood may outweigh the purely economic benefits.

Prehistoric and historic preservation can contribute to our quality of life by increasing our appreciation and understanding of our Nation's cultural and political history. Public education and interpretation play vital roles in preservation by enhancing the public's appreciation of our cultural heritage and involving the public in the preservation process. Yet competing mission demands within Federal agencies often cause them to neglect public education and interpretation. Hundreds of non-Federal historic organizations, such as Colonial Williamsburg, Virginia; Plimoth Plantation, Massachusetts; Cahokia Mounds State Historic Site, Illinois; and Santa Barbara Mission, California, have made significant contributions to the interpretation of prehistoric and historic cultural resources by instituting a variety of innovative volunteer and public-participation programs.

Because only a limited number of our cultural resources will be preserved with a high degree of authenticity, we must be able to understand the historical context in which prehistoric and historic activities took place. It is important to recognize the national, regional, or local significance of those sites, structures, and landscapes we wish to preserve. **Documentary research conducted at the outset of a project helps define the approach and focus of the preservation efforts. Historic materials are diverse and may include drawings, letters, maps, photographs, printed records, oral histories, and articles**. Even the existing data archives from any government agency are so numerous that current analytical techniques are often inadequate to search and evaluate them satisfactorily. **The vast amount of information available suggests preservation professionals need to gain intellectual and technological control over the knowledge base.** New information databases, automated finding aids, and related techniques are needed. A database of technical information would be particularly important.

Underwater archaeology and maritime preservation have made significant contributions to the understanding of our past, in many cases, as the direct result of the application of sophisticated technologies. If these gains are to continue, the information acquired in such studies must be integrated into the larger body of prehistoric and historic preservation information.

FEDERAL PRESERVATION POLICY

The Federal Government, "in cooperation with other nations and in partnership with States, local governments, Indian tribes, and private organizations and individuals," is responsible for providing leadership in preserving the Nation's prehistoric and historic cultural resources.[6] The National Historic Preservation Act charges the Secretary of the Interior and the independent Advisory Council on Historic Preservation with administering and guiding Federal preservation efforts. The National Park Service (NPS) acts as the lead agency in technical preservation matters for the Federal Government, and for State and local efforts. NPS, through a variety of "external programs," oversees the National Register of Historic Places, assists in historic survey and planning, and extends technical assistance to the preservation community, including other Federal agencies, States, and local governments. It administers, with the Internal Revenue Service, the tax incentives program to encourage private sector investment in rehabilitating certified income-producing historic structures. NPS also reviews State historic preservation programs and administers the matching grants-in-aid to the States for historic preservation projects. NPS protects and manages the cultural resources within the National Park system.

Every Federal agency has certain responsibilities for the prehistoric and historic properties under its control,[7] and must designate a qualified historic preservation officer.[8] The historic preservation officer plans for and coordinates the agency's preservation activities within the agency and with NPS.

The National Historic Preservation Act also established an independent Advisory Council, whose membership is composed of individuals from the private sector appointed by the President, to "advise the President and the Congress on matters relating to historic preservation, [and to] recommend measures to coordinate activities of Federal, State, and local agencies and private institutions relating to historic preservation."[9] It also "review[s] the policies and programs of Federal Agencies"[10] and writes and distributes general information on historic preservation. When a Federal undertaking would affect a historic property, the Advisory Council must be afforded "a reasonable opportunity to comment" on it.[11]

Additionally, the National Historic Preservation Act authorized and directed the establishment of a National Museum of the Building Arts. Among other things, the museum "shall collect and disseminate information concerning the building arts . . . and research relating to the building arts,"[12] which include information concerning building technologies and skills.

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[6] National Historic Preservation Act, Sec. 2(2).

[7] "The heads of all Federal agencies shall assume responsibility for the preservation of historic properties which are owned or controlled by such agency." National Historic Preservation Act, Sec. 110(a)(1).

[8] National Historic Preservation Act, Sec. 110(c).

[9] National Historic Preservation Act, Sec. 202(a)(1).

[10] National Historic Preservation Act, Sec. 202(a)(6).

[11] National Historic Preservation Act, Sec. 106.

[12] National Historic Preservation Act, Sec. 306(a)(1).

Each State has established a State Historic Preservation Office (SHPO), mandated by the National Historic Preservation Act. The SHPOs and the Certified Local Governments (CLGs), receive yearly matching grants from the Historic Preservation Fund to ensure that regional, State, and community preservation projects are carried out according to the nationally accepted standards. CLGs are approved by States and receive funding from them.

The National Trust for Historic Preservation, chartered and partially funded by Congress,[13] is also a source of information and expertise about technologies for preservation.

Applying Technologies in Prehistoric and Historic Preservation

Federal agencies can provide a variety of means for encouraging and facilitating the use of new technologies for prehistoric and historic preservation. However, participants in this assessment cited the following impediments to the adoption and widespread use of advanced preservation techniques:

- inadequate experience with and acceptance of new technologies,
- inadequate coordination among and within agencies,
- inadequate funding for technologies,
- inadequate training in the application of technologies, and
- inadequate technical information exchange.

Participants in this assessment cited the critical need to establish a federally funded institution as a mechanism to coordinate research, disseminate information, and provide training about new technologies for preservation. Several institutional structures are possible.

Federal Center for Preservation Technology.—Congress could establish such a center within the Department of the Interior or some other Federal agency. The center would assist the transfer of technology from other areas into prehistoric and historic preservation by developing new applications for existing technologies, providing training for preservation professionals, and serving as a clearinghouse for disseminating information on preservation technologies. A center should have a small but highly trained staff and the facilities for developing technologies relevant to all phases of the preservation process.

A Federal center, based within the Department of the Interior, would have the advantage of consolidating much of the specialized technological expertise now spread throughout the Department of the Interior and other Federal agencies. It could also increase administrative efficiency and lower costs by reducing redundancy of personnel and consolidating overhead. In addition to serving as the focal point for technology-related preservation information within the Federal Government, such an institution would provide needed assistance to State and local governments and to the private sector. All agencies and private individuals and groups would

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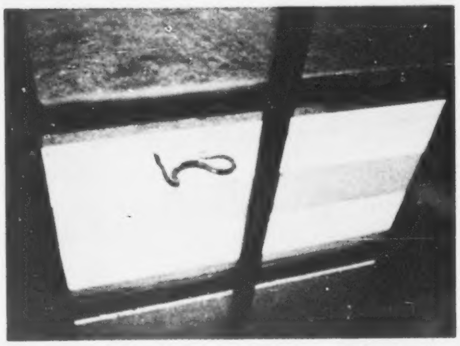
[13] The National Historic Preservation Trust Act of 1949 (Public Law 81-408; 63 Stat. 927).

Bird Control Technologies



The imitation snake represents a "low-tech" solution to the problem of damage from bird droppings.

The device behind Lincoln's head is an ultrasonic device for preventing birds from roosting on the statue.

Photo credits: Preservation Assistance Division, National Park Service

have a central place within the Federal Government to look for technical help with preservation problems.

National Center for Preservation Technology. —Alternatively, Congress could create a National Center for Preservation Technology, outside the Federal Government and managed by a consortium of universities. Such an institution would be able to draw on a multitude of different skills in several universities, and in many university departments. Like the Federal center, it would develop and test new applications of technologies, conduct training, and distribute information. However, it would be free to contract with agencies and with States and the private sector to develop technologies of specific interest to them. Because it would also otherwise be free of the institutional constraints and pressures imposed by being housed within the Federal structure, such an organization might be more innovative than a Federal laboratory. Though a National Center would serve as a resource for the Federal Government, like the Federal center outlined above, it would also serve State and local needs.

The National Astronomical Observatories, which are managed by the Association of Universities for Research in Astronomy, Inc., and funded by the National Science Foundation, might serve as an appropriate model. They not only provide research facilities for the entire astronomical community, but also conduct their own research projects.

Because a national center based in the university community would support Federal preservation efforts, it would require some Federal funding. This option would be an excellent opportunity to strengthen public/private ties for prehistoric and historic preservation, which have always been important features of the preservation movement. Thus, the center could derive a significant percentage of its operating expenses from State and private sources.

Preservation Technology Board.—Additionally, Congress might wish to consider supporting a Preservation Technology Board. Even if one of the two options for creating a Center for Preservation Technology were adopted, a board composed of professionals from all parts of the preservation community would be needed to provide guidance for a center, and to determine current needs for technology, develop standards for the application of new technologies, and assist in disseminating information. The professional societies concerned with archaeology, historic structures, and historic landscapes are likely to be highly supportive of such a Board.

The preservation efforts of the Federal agencies would benefit immeasurably by a Preservation Technology Board. Congress could foster its creation by directing the Federal agencies with major responsibilities for prehistoric and historic preservation to provide initial funding.

Federal Management of Historical Cultural Resources

A thorough assessment of the Federal institutional structure for prehistoric and historic preservation is beyond the scope of this assessment. However, participants in the OTA workshops expressed marked concern over the institutional impediments within the Federal Government that limit its effectiveness in applying a fuller range of technologies to preservation.

The stewardship of prehistoric and historic archaeological resources, historic structures, and historic landscapes has not received sufficient attention within the Department of the Interior. Even within the National Park Service, which carries out many of the Federal responsibilities for prehistoric and historic preservation, the management of programs relating to other Federal, State, and local cultural resources often conflicts with NPS's priorities in caring for natural resources in the Nation's parks. Yet, of the 337 units of the National Park system, two-thirds were established because of their prehistoric and historic resources. All NPS parks contain some prehistoric and historic cultural resources.

In order to implement fully the provisions of historic preservation legislation (table 1), it would be important for the Federal Government, including Congress, to increase its attention to prehistoric and historic preservation. Federal programs have often served as models for the States, local governments, and private preservation efforts.

In view of the concern over the management of the Federal Government's preservation efforts, Congress may wish to consider changing the structure of the Federal Government's preservation efforts. The following paragraphs present options for improving Federal management of cultural resources.

Establish a Separate Agency To Manage and Coordinate All Federal Cultural Programs.—In addition to providing a central focus for all the government's programs in preservation, such an agency would be responsible for administering the National Endowment for the Humanities, the National Endowment for the Arts, and other culturally oriented programs. It would in essence be similar to a Ministry of Culture, which most foreign governments have.

Create an Independent Agency Devoted to the Care and Protection of Prehistoric and Historic Cultural Resources.—Such a policy has the major advantage of providing coherence for the management of U.S. prehistoric and historic preservation programs. It would remove the primary responsibility for cultural resources management from the Department of the Interior, yet it would create a new institution that must be staffed and funded (though many staff, and some funding would result from transfers from existing programs). An independent agency would be the logical place for the Federal Center for Preservation Technology suggested above. However, it would lack the benefits of in-house expertise in the actual ownership and management of historic properties.

Reorganize the Department of the Interior To Provide for an Assistant Secretary for Natural and Cultural Resources.—This option would bring all the cultural programs from NPS and other DOI agencies under the aegis of one office. It would be simpler to effect than creating an independent agency, and would increase the visibility and importance of preservation within the Department of the Interior. However, it would continue the current arrangement of maintaining the preservation function within the department, which as noted earlier, carries disadvantages as well as advantages for the national preservation programs.

Work Within the Current Preservation Structure.—Even if the overall management structure for the Federal preservation effort were left largely unaltered, the agencies could make several changes to improve this Nation's preservation effort, within the direction provided by the National Historic Preservation Act, and other legislation. The initiation and execution of such programs will require direction and continued oversight by Congress. The agencies could:

- inventory their preservation needs and plans for carrying them out;
- develop sustained, organized maintenance programs for historic Federal properties;
- improve coordination and information-sharing among agencies with respect to historic preservation;
- develop a stronger focus on the application of new, efficient technologies for preservation; and
- establish a central office to collect and disseminate information about preservation technologies.

Survey of Prehistoric and Historic Landscapes

The United States has made no comprehensive survey of significant national prehistoric and historic landscapes comparable to its efforts for historic structures. Because prehistoric and historic landscapes are an especially ephemeral resource, some groups are now surveying them. For example, the State of Ohio has an ongoing survey of historic landscapes. New Mexico has also conducted landscape studies.

In 1984 the Historic Preservation Committee of the American Society of Landscape Architects initiated a national survey of historic designed landscapes, which is endorsed by the National Park Service. This important example of a public/private partnership depends primarily on volunteer

Photo credit: HABS/HAER, National Park Service

Cascade area, Meridian Hill Park, Washington, DC

assistance from many regions of the United States. However, without professional, full-time leadership, relying entirely on volunteers from different regions may lead to inconsistent survey results. The National Park Service could assume a stronger role than it has taken in this effort, in order to assure timely completion of the survey and to standardize the information collected. Congressional oversight may be necessary to assure that this process takes place.

Significant prehistoric and historic landscapes continue to be lost through lack of recognition. The proposed Olmsted Heritage Landscapes Act of 1985[14] (Olmsted Act—H.R. 37), seeks to "encourage the identification, preservation, and commemoration of historic designed landscapes."[15] Limited surveys have been conducted on Olmsted landscapes by the National Association of Olmsted Parks and the Massachusetts Association of Olmsted Parks. These primarily volunteer efforts cannot discover all significant Olmsted landscapes. Although the Olmsted Act is directed toward the parks designed by Frederick Law Olmsted's firms, which include some of the most famous and historically significant of U.S. parks,[16] **passage and implementation of the Olmsted Act would materially aid the collection of information on all U.S. historic designed landscapes. Focusing attention on the Olmsted landscapes would also enhance public awareness of other significant landscapes.**

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[14] See, however, *The National Historic Preservation Act: An Assessment* (Washington, DC: Advisory Council on Historic Preservation, September 1986) for a discussion of many of the broader institutional issues faced by preservation efforts in this country.

[15] Sec. 4 of H.R. 37.

Historic Shipwrecks and Other Submerged Cultural Resources

The United States has not undertaken a national inventory of submerged cultural resources, which include submerged villages and other sites as well as shipwrecks. Although some States have made substantial progress in surveying their own coastal and riverine areas, and locating submerged resources, no States have comprehensive data on file.

Historic shipwrecks in coastal waters contain a wealth of important information concerning the exploration and settlement of this country. Yet efforts to protect them for research and public interpretation are hampered by current Admiralty Laws, under which historic shipwrecks are treated as abandoned property. Their contents may be recovered by salvors. Such recovery often destroys valuable information related to the Nation's maritime history. **Passage and implementation of the proposed Abandoned Shipwrecks Act (H.R. 3558/S. 2569) would make it possible to preserve significant historic shipwrecks for future generations by ceding jurisdiction, ownership, and oversight of them to the States.** The Senate version is almost identical to the House version, and maintains incentives for sport-divers and salvors to continue searching for historic shipwrecks. It would also guarantee salvors "reasonable compensation" for work undertaken under its terms.

The important additional attention to submerged prehistoric and historic cultural resources that passage of the Abandoned Shipwrecks Act implies may require the National Park Service and the National Oceanic and Atmospheric Administration to increase their funding and other support of submerged cultural resources activities. Congressional oversight may be necessary to guarantee that such requirements are met.

Protection of Prehistoric and Historic Cultural Resources

Looting and vandalism are serious threats to the management and conservation of prehistoric and historic cultural resources. The activities of looters are particularly damaging to prehistoric sites because they destroy important and valuable scientific information. Painting graffiti, breaking windows, destroying shrubs, and other acts of vandalism reduce the value of historic structures and landscapes and make them much less attractive to visitors. Advanced monitoring and observation devices may aid the law enforcement process. However, they cannot substitute for the presence

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[16] Over three generations, the Olmsted firms, whose Brookline, MA, office is now a National Historic Site, managed by the National Park Service, designed such parks as Central Park in New York City, Franklin Park in Brookline, MA, and Prospect Park in Brooklyn, NY, as well as estates, universities, park systems, institutional properties, and urban plans.

Photo credit: Submerged Cultural Resources Unit (SCRU) National Park Service

Stop 6 on underwater trail in Isle Royale National Park, Lake Superior, Michigan. Photo shows diver preparing to attach marker to the wreckage of the passenger/package freighter Monarch that went down in a storm in December 1906.

of trained officers in the field. Adaptive reuse of cultural resources imparts a natural element of protection by giving them value beyond their historic value.

The high value placed on some items in national and international markets and the lack of consistent law enforcement in dealing with illicit excavation on public lands and trafficking in stolen artifacts, make protection of sites and structures as well as prosecution for illegal activities extremely difficult. Professional thieves are technologically well-equipped and motivated by strong economic incentives to continue their activities. **In addition to employing trained personnel and applying appropriate technologies, the United States needs to improve the enforcement of its policies for dealing with illicit excavation and trafficking in stolen artifacts.** Congressional oversight of the implementation of existing legislation may be necessary to encourage such enforcement.

Recent technological advances could enable relatively easy registration and coding of artifacts for sale. To assist in stemming the illegal loss of irreplaceable artifacts from public lands, and the concomitant damage that looting causes, **it may be appropriate to amend the Archaeological Resources Protection Act of 1979 and other statutes to permit private registration of antiquities obtained in the course of archaeological excavations, conducted by trained archaeologists on private land.** Registration would make it easier for law enforcement officials to obtain convictions for illegal sale of unregistered artifacts taken from public lands, by shifting the burden of proof that the artifact was dug on private land from the government to its owner. To be most effective, registration should include sufficient information about the artifact to allow the owner to understand its archaeological origins and connection to the prehistoric peoples from which it derives.

Registration of scientifically excavated artifacts is likely to enhance the value of registered artifacts relative to unregistered ones. Such increase in value might provide economic incentives for private landowners to have their sites properly excavated and recorded, rather than dug solely for their marketable artifacts. Registration might also assist in educating landowners to the scientific value of using the best possible excavation methods. However, sale of artifacts from excavations would have the disadvantage of dispersing some collections, rendering them less available for restudy.

The Convention on Cultural Property Implementation Act[17] prohibits importation of stolen cultural property that is documented as belonging to the inventory of a public monument, museum, or similar institution in a State party to the UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property.[18] It also restricts archaeological or ethnological materials from other countries upon request and subsequent agreement by the United States. However, it is just being implemented and further experience will be needed to test its efficacy in stemming the international flow of cultural property.

U.S. law does not protect against export of irreplaceable items of U.S. cultural history from the United States to other countries. The UNESCO Convention encourages each State party to register cultural property[19] for the purposes of controlling import into other countries. **As experience is gained with implementing the Convention on Cultural Property Implementation Act, it may be appropriate for the United States to explore ways in which the registration of artifacts suggested above could be expanded to other prehistoric and historic cultural property for international trade.**

THE PRESERVATION PROCESS

The process of sound cultural resource research and management is extremely complex and involves individuals from a variety of disciplines. It can be divided into the following components, which are not necessarily listed in order of application:

- discovery (identification and survey);
- recording and measurement;
- analysis and evaluation;
- restoration, conservation, and maintenance;
- protection from catastrophic losses;

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[17] Public Law 97-446.

[18] Fifty-eight countries have signed the UNESCO Convention

[19] See articles 6 and 10 of the UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property.

- data and information storage and retrieval; and
- public education and involvement.

These components make use of a broad array of rudimentary, as well as sophisticated, technologies. Many new technologies promise to enhance the process of prehistoric and historic preservation. However, they must be appropriate to the task to which they are applied. In some cases, traditional methods (so-called low-tech solutions) may be the most appropriate and cost-effective.

Some Research Technologies Discussed in the Report

Discovery

Remote Sensing.—Includes techniques of imaging Earth from spacecraft and aircraft. Also includes surface methods and geophysical methods that penetrate below the surface of the Earth, or underwater.

Aircraft and spacecraft methods:

- *photography*: black and white, color, and infrared at a wide variety of scales;
- *multispectral scanning*: electronic sensing and processing of visual images in many spectral bands, including infrared; and
- *imaging radar*: builds image of surface topography by analyzing a series of microwave radar scans. It can even be used to penetrate below the surface of dry soil;

Subsurface methods:

- *georadar*: detects reflections of microwaves, transmitted by radar carried along the surface, from cultural material below the surface;
- *soil resistivity meter*: measures electrical resistance of soil to the passage of a small current from probes placed in soil; cultural material generally displays different resistance from surrounding soil;
- *soil conductivity meter*: measures conduction of current passed between two probes placed in soil; cultural material generally displays different conductivity from surrounding soil;
- *magnetometer*: registers changes in the local magnetic field as detector passes over iron-bearing cultural material; and
- *metal detector*: finds subsurface metals by detecting small electric currents (eddy currents) generated in the metal by electromagnetic pulses transmitted by the instrument.

Underwater methods:

- *side-scan sonar*: locates shipwrecks and sites on the bottom surface by detecting the echoes of high-frequency acoustic pulses transmitted from instrument towed behind ship;
- *sub-bottom profiler*: locates shipwrecks and sites below the ocean bottom by detecting the return signals of lower frequency acoustic pulses from instrument towed behind ship;

- *magnetometer:* similar in principle to the magnetometer for use on land. It detects changes in the magnetic field as detector passes over iron-bearing cultural material. It can be used from a ship or an airplane; and
- *remotely operated vehicles (ROVs)*: a variety of submersible vehicles that can carry photographic or video cameras to image submerged objects. ROVs can also retrieve samples from the bottom.

Surface methods:

- *video*: color and black and white; and
- *photographic cameras*: can be operated in infrared as well as color and black and white.

Predictive Locational Modeling.—This term is applied to a group of techniques, often requiring a computer, employed to predict the distribution of archaeologically significant material in a region by analyzing such factors as climate, soil characteristics, landform characteristics, and the availability of crops and game.

Documentation

Photogrammetry.—This precision recording technique makes use of a stereo pair of photographs, the details of which are analyzed in a stereo comparator and plotted on a precision plotter. Most recent versions of the method, called analytical plotting, make use of computers to assume most or all of the burden of analyzing the stereo photographs. The method can be used to record extremely fine details of a site, structure, or landscape for later three-dimensional analysis.

Close-Range Inspection.—This includes a variety of techniques for studying the surfaces or interiors of structures in detail. In addition to visual analysis under bright light, or photography, such methods include:

- *infrared inspection*: the use of infrared light and infrared sensors to reveal surface detail invisible to the naked eye;
- *ultraviolet inspection*: the use of ultraviolet light (often called black light) to reveal surface detail invisible to the naked eye;
- *X-ray inspection:* the use of X-rays to explore the interior of structural material (primarily plaster and wood);
- *neutron-gamma ray inspection*: the use of neutron-emitting radioactive sources to determine the chemical constituents of structural materials. High energy neutrons strike atoms of structural material causing them to emit gamma rays characteristic of the material. Analysis of the energies of the detected gamma rays can be used, for example, to determine the kinds, distributions, and amounts of contaminants within structural materials without cutting, coring, or otherwise disturbing them.

Archival

Information Systems.—Computer technology makes nationwide links between archives and libraries possible. Keyword systems allow efficient searches for materials that may be located in many different places. They also permit the listing of diverse kinds of archival and library holdings, such as papers, maps, photographs, charts, books and films, under one subject heading.

Optical Disk Storage.—Optical, or laser, disk storage is a highly powerful medium for storing and retrieving large amounts of visual, print, and voice data quickly. It works much like a compact record disk, using a small laser to read the disk's surface, but can store and display full motion video as well as still photographs and text. A single optical disk can now store approximately 54,000 single images on one side.

Analysis

Geographic Information Systems (GIS).—These are computerized database systems in which the data are explicitly spatial in nature and organization. They can be used to accumulate many kinds of data, such as soil type, distribution of sites or structures, plant type, and population distribution and display them in a variety of ways to reveal patterns of settlement, land use, or other spatial patterns.

Dating Techniques.—A wide variety of direct dating techniques are available that use chemical, physical, or visual analysis.

- *dendrochronology*: commonly known as tree ring dating, this technique relys on the fact that climate, water, and soil conditions make trees grow at different rates from year to year. Visual inspection of the patterns of tree rings yield highly accurate cutting dates for logs.
- *radiocarbon*: depends on the slow decay of carbon-14 in organic compounds. The amount of carbon-14 in organic materials remains in equilibrium with the atmosphere while organisms are still alive. The approximate date they die can be determined by measuring the current ratio of carbon-14 to carbon-12 in samples.
- *archaeomagnetism*: depends on the slight change of direction and strength of Earth's magnetic field over time. Iron-bearing particles, when heated, for example in a fire hearth, become free to assume the magnetic direction of the local field of the Earth. After the hearth cools, the magnetic field of that epoch is sealed in the iron-bearing material. Comparison of the sample's magnetic field direction with the present magnetic field yields an estimate of the sample's age.
- *obsidian hydration*: depends on the fact that the outer surfaces of freshly flaked obsidian will take on water from the atmosphere over time. By measuring the amount of water in the outer layers of a sample of obsidian, it is possible to estimate how long ago an obsidian flake was made.

NOTE: This list is illustrative of the many technologies applicable to preservation rather than comprehensive. Most of the technologies in this brief list can be applied in other phases of the research process than those for which they are listed. For example, although predictive locational modeling is listed as a technology for discovery, it is also a potentially powerful analytic tool.

Discovery

Archival investigation is an important first step in the discovery phase of the preservation process. Before beginning actual fieldwork, archival materials and oral histories related to the project should be collected and studied. They are especially helpful in focusing the research problem and aiding creation of a detailed research plan. Efficient data management systems are needed for archival investigation. These include subject-accessible keyword systems and finding aids that relate to the geographic location of sites. Careful notation of the field survey and inventory data for later use and archival storage requires the design of collection forms that can be easily read by automated information systems.[20]

Remote sensing techniques using both aircraft and spacecraft, as well as close-range sensors, appear to offer great promise in extending our ability to discover, characterize, and study archaeological sites and historic landscapes. Yet, high costs of equipment and lack of familiarity with remote sensing techniques have inhibited their use in archaeology and landscape studies. Although remote sensing techniques are little used in identifying historic structures, they can improve our understanding of the significance of these structures by revealing new contextual information.

Geographic information systems and predictive modeling methods are also finding utility for survey and identification of archaeological sites and landscapes. Ultimately, locational predictive modeling techniques, analytical tools for predicting the distribution of archaeologically significant material across large regions, are likely to prove powerful aids for research and management of cultural resources, especially in the vast public lands of the Southwest and West. However, such models need considerable refinement, and may never reduce the overall costs of surveying and identifying archaeological sites.

Underwater archaeology depends primarily on technologies borrowed from the oil and gas exploration industry. The costs of using such survey technologies as side-scan sonar, sub-bottom profilers, remotely operated vehicles, and precision positioning systems are likely to remain extremely high. However, the data for initial surveys in shallow coastal waters may be available from the exploration firms and the Minerals Management Service at extremely low cost. Magnetometry, the most widely used of underwater locational technologies is less costly, but responds only to ferrous material. Using airborne magnetometers would reduce the costs of surveys by allowing rapid coverage of large areas of water.

Video technology, because it is relatively simple and inexpensive to use has broad applications for survey and identification, can store vast amounts of information about the context of historic structures, and is capable of imparting a sense of presence, place, and context that individual photographs cannot. It has also found considerable use in underwater archaeology, for survey and interpretation of submerged resources to the public.

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[20] For example, the Wisconsin State Historic Preservation Office has devised a sites and structures form, which can be read efficiently by an optical character reader.

Radar Image of Death Valley, California

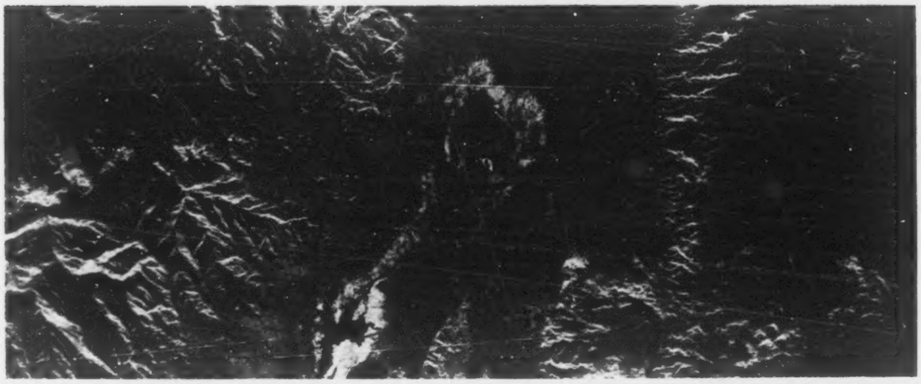

Photo credit: Jet Propulsion Laboratory and National Aeronautics and Space Administration

A variety of geologic features can be seen in this radar image acquired by the Shuttle Imaging Radar-B carried aboard the space shuttle, Oct. 11, 1984.

During the last two decades, significant strides have been made in the drive to recognize significant landscapes. However, only within the last year have landscapes been incorporated within the significance categories for the National Register of Historic Places.[21] Such an omission has constituted a major barrier to nominating landscapes to the Register.

Recording and Measurement

Photogrammetric stereo recording of archaeological sites, historic buildings, and landscapes is underutilized in the United States, in large part because of a lack of appreciation of its benefits in heightened accuracy and speed of execution, as well as the requirement for trained staff and specialized equipment. Recent advances in computer software, brought about by extensive research on remote sensing from aircraft and spacecraft, coupled with relatively inexpensive image digitizers, promise to lower costs dramatically. Stereo photogrammetric techniques are also being applied to documenting submerged cultural resources.

Excavation is necessarily destructive. There is therefore a strong need to improve the quantity and quality of archaeological data recording. It is also important to refine the techniques for locating the most suitable sites for excavation. **Many experts feel that archaeologists need to excavate less and record sites more carefully. They might also benefit from standardizing the process of gathering data so there is less onsite analysis.** Microanalytic soil and plant techniques have improved dramatically in the past decade. In addition to storing records and artifacts, archaeologists would benefit from saving soil samples, corings, and excavation profiles for future reanalysis of sites when techniques have improved still further.

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[21] See J. Timothy Keller and Genevieve P. Keller, "How To Evaluate and Nominate Designed Historic Landscapes," Bulletin #18, National Park Service, 1986. This document represents the first attempt within the U.S. preservation movement formally to signify the importance of landscapes to the U.S. cultural heritage. The preservation of cultural landscapes has also received relatively little attention. See Robert Z. Melnick, *Cultural Landscapes: Rural Historic Districts Within the National Park Service* (Washington, DC: National Park Service, U.S. Department of the Interior, 1984).

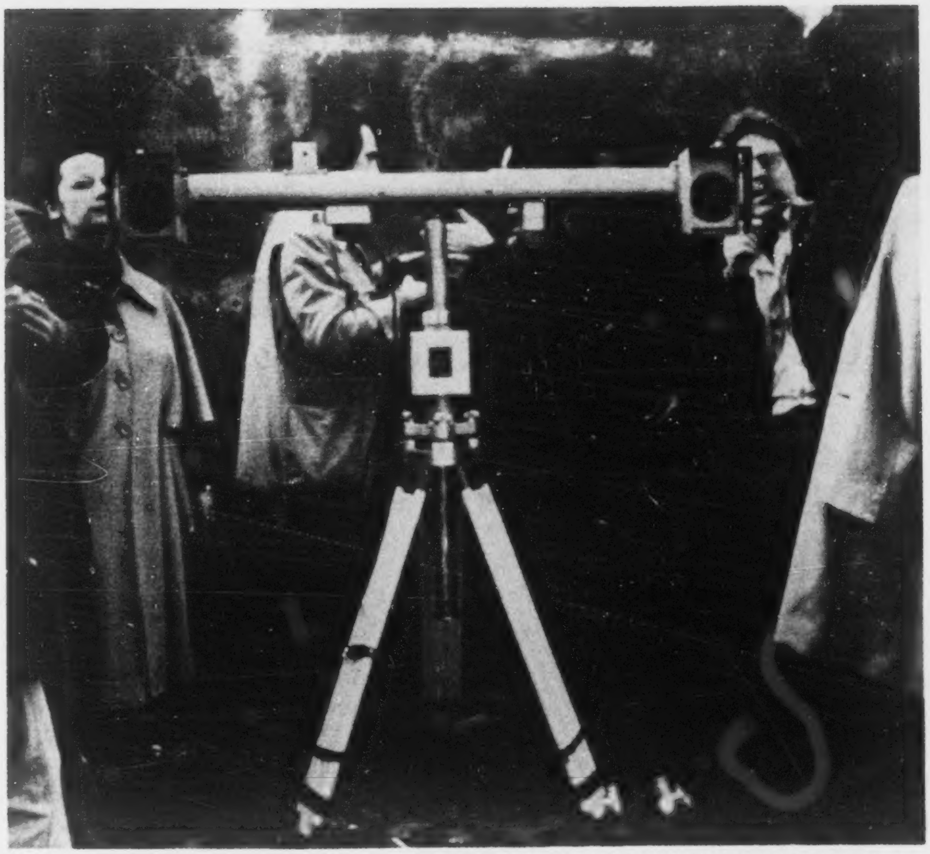

Photo credit: Preservation Assistance Division, National Park Service

Stereo photogrammetry in Rome

Underwater archaeologists need greater access to the dramatically improved deepwater remotely operated exploratory vessels developed for the U.S. Navy, and the oil, gas, and mineral industries. Because submerged wooden vessels, the largest of all artifacts, are extremely fragile, they would also benefit from the development of technologies that would enable shipwrecks to be examined and their contents excavated with minimal disturbance to the structures themselves.

The detailed examination of the surfaces of historic structures benefits immeasurably by using infrared and ultraviolet techniques. X-ray and neutron-gamma ray devices make possible the nondestructive examination of internal or hidden structural details.

Optical disk technology allows the storage and retrieval of diverse kinds of information on all preservation issues. Photographs, videos, test results, field notes, and other kinds of information can be stored together in one place to facilitate access.

Analysis and Evaluation

Accurate dating of archaeological materials plays an important part in understanding prehistoric cultures. The several dating techniques developed for archaeology are excellent examples of the transfer of technology from the natural sciences into archaeology. Traditional radiocarbon dating techniques, which were developed by chemists, have proved powerful tools for determining the ages of organic material. However, because many of the artifacts archaeologists wish to date are extremely small, they are limited by the amount of the sample (about a gram) needed compared to the size and mass of the artifacts. Recent advances in radiocarbon dating yield acceptable results with samples 1,000 to 1 million times smaller. Other advances in dating techniques, such as archaeomagnetic dating, which was developed by geophysicists and depends on measuring changes in the Earth's magnetic field over time, have dramatically extended the archaeologists' ability to date archaeological remains.

Archaeologists have usefully applied the analytical techniques derived from soil science and geomorphology for many years. Techniques derived from the earth sciences have much to contribute to the management of archaeological sites and historic landscapes. Continued improvements in such techniques will be important in assisting the research of archaeologists and landscape historians.

Landscapes are subtle and constantly changing as a result of both natural and human processes. Computer modeling and remote sensing techniques provide a powerful set of techniques for the analysis and evaluation of large-scale landscapes. Analysis of landscapes requires understanding of plant types and plant variations. For historic gardens, the identification and retrieval of historic plant types is particularly important. There is a strong need to develop databases on the types of plantings used historically. Such databases will also depend on maintaining archives on the types of plants used historically in the United States.

Even though historic structures were built in stages and are composed of many different subsystems, they nevertheless function as a total interdependent system. **It is essential to analyze their performance as a whole, rather than a sum of independent component parts.** Architects must be trained correctly to analyze and predict the behavior of structural elements over time in different environmental conditions. Structures also exist as part of a total landscape and should be analyzed within that context rather than being considered independent of their surroundings.

Considerably more progress is needed in nondestructive assessment of structural condition. X-ray and gamma-ray devices can locate hidden features of structures. They can also be used to determine and diagnose moisture and deterioration of structural elements.

Restoration, Conservation, and Maintenance

Regular, periodic maintenance plays a crucial part in conserving prehistoric and historic sites, structures, and landscapes and enhances their

Structural Damage

Brownstone deterioration as a result of splashback from traffic on stairs.

Ice damage to stone.

Photo credits: Preservation Assistance Division, National Park Service

value. **Yet relatively little attention has been given to training for maintenance** or **applying technology to improving maintenance management.** Long-range management is especially important. Expert systems and optical disk technology can vastly improve the delivery of quality training in restoration, repair, and maintenance. Craftspeople skilled in restoration techniques should be made part of the decisionmaking process for restoration, conservation, and maintenance. Proper cyclic maintenance for sites, structures, and landscapes includes a thorough understanding of both traditional and advanced techniques.

Materials recovered from submerged sites pose particularly difficult conservation problems. They become highly vulnerable to the process of decomposition almost immediately after being removed from the water, and require perpetual, not just cyclic, attention.

Because local residents often have a major stake in the subsequent use of a preservation project, they should be consulted during the analysis of sites, structures, or landscapes prior to restoration. A variety of analytic interview techniques speed this process and make it more accurate. It is also important to gather and store interview materials properly in archives so they may be used effectively.

Participants in this assessment noted that **many contemporary buildings reflect inadequate knowledge of materials and construction methods. They could become the preservation problems of the future.** It is important to give more attention both to understanding materials and developing standards for construction. Information that is collected in the investigation of historic building materials may be extremely useful for refining current building techniques and developing proper maintenance plans. In particular, **reinforced concrete, one of the most common of building materials, is failing in both modern and historic structures because its behavior has not been well understood. Reinforced concrete constitutes a growing and burdensome conservation problem for the future.** Effective conservation treatments should be found and that information widely shared.

Environmental stresses on historic structures have increased markedly in the last century. Technologies for conserving historic structures against rapidly accelerating degradation by chemicals and water in the atmosphere and soil are needed.

In an effort to reduce costs, or meet local building codes, substitute materials are often employed in restoring historic structures. The behavior of these substitute materials also requires detailed analysis before they are used in order to assure that they will last and will be compatible with the original materials and appropriate to the structure.

The Federal effort at stabilizing and conserving prehistoric and historic sites and structures suffers from lack of agency coordination. Considerably more research needs to be done, for example, on technologies for site monitoring, and the stabilization of adobe, stone, and wood.

The conservation of prehistoric and historic rock art[22] has received very little attention from Federal agencies. **Because of the importance of rock art to understanding prehistoric Native American culture, a focused effort to develop appropriate conservation technologies is very important.** Conservation of rock art is also important to many contemporary Native Americans as it is part of their cultural heritage.

As a result of the multitude of stresses that the urbanization of the United States places on the natural environment, it is more important than ever to identify and manage significant prehistoric and historic landscapes. **The United States is losing significant numbers of historic plant species. In order to reduce such losses, and make it possible to restore historic gardens accurately, it may be necessary to establish arboretums to conserve and propagate historic plant species.** Arboretums, such as the one at Jefferson's home, Monticello, and many historic gardens, could also play an important role in maintaining the diversity of plant species.

Records that document the maintenance and preservation of sites, structures, or landscapes can be used to make informed decisions about which technologies will work best and be most cost-effective. Yet such important documents are often not retained because they are considered unimportant as "housekeeping" information.

Protection From Catastrophic Losses

Prehistoric and historic sites, structures, and landscapes are subject to a variety of catastrophic losses, including fire, earthquake, looting, and vandalism. **Under certain circumstances, technologies for the detection and surveillance of intruders and potential arsonists or vandals can enhance the protection of cultural resources. However, the costs of such technologies are extremely high. In addition, patrols by trained law enforcement officials are also necessary.** Urban, rural, and underwater environments require different approaches to law enforcement. Public educational and other regular and constant uses of historic properties can contribute to their protection by ensuring that people are often present at times of high potential risk.

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[22] Rock art includes rock painting (pictographs) and rock carving, incising, and pecking (petroglyphs).

Cultural resources on Federal lands belong to the Nation and are held in trust by Federal agencies for the benefit and enjoyment of all citizens. Increasing the effectiveness of law enforcement for the protection of cultural resources on Federal lands will require better coordination among Federal agencies for training and sharing of information.

Methods for protecting historic structures located within earthquake zones, particularly in cities, has begun and should continue. However, historic structures are more frequently lost from neglect than from catastrophic events. Some are deliberately destroyed by their owners because they have little notion of why they should be preserved.

Historic structures are particularly vulnerable to arson and intrusion. Devices designed to monitor for fire and intrusion must be simple to operate and maintain. Those that can be operated and understood only by trained experts may do more harm than good if they malfunction or create a false sense of security.

Photo credit: Jack Boucher, National Park Service

Carson House, Eureka, California

Preservation Information

Efficient access to information remains one of the greatest impediments to effective management of cultural resources. New means of recording, storing, retrieving, and manipulating data and information promise to improve dramatically our ability to identify and preserve significant prehistoric and historic sites, structures, and landscapes. The most consequential advances are expected from the application of optical disk technology in various forms, which will allow the storage and retrieval of prints, photographs, and video as well as text. Optical character readers for translating text to machine readable format will improve preservationists' ability to create databases and enhance the flow of information. However, making effective use of such technologies will require the development of standardized formats for data collection and recording. Improved coordination within the preservation community could assist the development of such standards.

Participants in this study expressed considerable concern about the long-term stability and storage quality of new data and information media and equipment. **It will be essential to continue to study the longevity of such media and equipment and to develop systems that are evolutionary, rather than revolutionary, in order to reduce the costs and disruption to records that abrupt technological shifts might cause.**

Public Education

Public education and interpretation are among the most effective means of preserving prehistoric and historic sites, structures, and landscapes for future generations to enjoy. Long-term storage issues aside, creative use of video and interactive optical disk technologies can significantly enhance the quality of preservation education and interpretation. Electronic media make possible public involvement with the educational materials because they allow direct interaction with the media. Programs on optical disks, especially, could encourage viewers to select different paths of information and to individualize their educational experience.

Many people are simply not aware of the threat that vandalism and looting pose for this country's cultural resources. Improved education concerning the benefits of preserving our cultural resources would enhance efforts to protect them. **The Federal Government should take a leading role in educating citizens about the loss of U.S. cultural resources and what they can do to help preserve them. It should also demonstrate strong management policies with respect to the properties it oversees.**

Museums are a major source of public education about U.S. cultural resources. Yet they often fail to inform the public adequately on the need to preserve prehistoric and historic cultural resources. They should be encouraged to provide better education concerning the threats to cultural resources in the United States and abroad. This may require modest amounts of additional funding for museums.

Techniques that allow the public to observe safely the course of an excavation or restoration add significantly to its understanding and sympathy for the goals of prehistoric and historic preservation. The process itself then functions as an educational tool.

Historians can provide the broad historical context needed for interpreting the past. Historians, particularly those involved in public history studies and programs, should be involved in the interpretation process from its beginning through production of the end product or performance.

SOURDOUGH
HOT MEALS
CAFE
COLD DRINKS
OPEN

Photo credit: Robert L. Spude, National Park Service

Sourdough Roadhouse, Alaska, a National Historic Landmark. This roadhouse was built on the trail from Valdez on the coast to the gold fields of Fairbanks; the trail that parallels the Alaskan pipeline today. The roadhouse has been operating continuously since ca.1905, when it was built.

NOTE: Copies of the report "Technologies for Prehistoric and Historic Preservation" can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, GPO stock No. 052-003-01051-8.

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The Social Security Administration and Information Technology

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Special Report

CONGRESS OF THE UNITED STATES
Office of Technology Assessment
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Foreword

The Social Security Administration in 1982 announced its Systems Modernization Plan (SMP), designed to restructure and extensively upgrade its data-handling systems. The agency told Congress that, without this major upgrading, there might be serious disruption of its services, which are essential to the welfare of millions of Americans. The SMP was one of the most expensive civilian information projects ever undertaken; it has since become a "rolling" 5-year plan with projected costs currently estimated at nearly $1 billon.

The disruption of services that the Social Security Administraton feared in 1982 has been averted, but the SMP and its implementation have been the subject of continuing controversy and criticism within the Administration and in congressional oversight committees. The Social Security Administration has scheduled major procurements in fiscal year 1987 that are central to implementation of SMP.

In this special report, OTA examines the objectives and technical strategies embodied in the SMP and the progress that the Social Security Administration has made toward its implementation. The report calls attention to some general problems faced by both SSA and other Federal agencies that are increasingly dependent on communications and information technology in carrying out their missions.

OTA appreciates the participation of the advisory panelists, workshop participants, Federal agency officials, and interested citizens, without whose help this report would not have been possible. The report itself, however, is the sole responsibility of OTA, not of those who advised and assisted us in its preparation.

John H. Gibbons

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Summary

In 1982, the Social Security Administration (SSA) announced a 5-year plan to modernize its information systems. The Systems Modernization Plan (SMP) was a multimillion dollar response to serious problems that had developed during the 1970s, and that repeatedly threatened to disrupt SSA's services delivery operations. Congressional oversight had identified many of these problems, but had not fully revealed their persistent, deep-seated, and cumulative effect on the agency's ability to respond efficiently to congressional mandates and priorities.

This special report explores the factors that led to SSA's information systems problems. It concludes that other Federal agencies are vulnerable to similar problems as they automate and modernize data-handling operations. It also concludes that effective oversight and monitoring of agencies dependent on advanced information systems is becoming more difficult, as technological decisionmaking and management increasingly requires specialized knowledge.

Issues for Congress

The basic strategy of SSA's SMP as set out in 1982 is reasonable and defendable in the sense that it is consistent with accepted systems engineering practices. Some experts argue that alternative strategies should have been adopted, such as regional decentralization of data processing. However, whether or not the original decisions were the best ones, the alternative strategies also have disadvantages and risks; they cannot be shown to offer stronger guarantees of success than does SMP. Achieving SMP's objectives now depends on SSA's technical competence, on the quality of its management as it implements the SMP, and on certain factors outside of the agency's control, including Administration policy and directives.

SSA has made significant progress toward achieving the goals of the plan in many areas, especially hardware acquisition. In other areas, SSA has fallen behind. The report identifies a series of serious unresolved problems in software engineering, database architecture, and database integration. Even though the strategy is sound, these problems cast doubt on SSA's understanding of the nature of some technical questions, and its commitment to the quality of management that is essential to success of SMP.

This report also raises strong questions about the reliability and completeness of the information that SSA has provided to Congress and to the public about its progress in SMP implementation. Congress may therefore want to intensify its monitoring and oversight of all aspects of implementation, to make sure that the goals of systems modernization, efficient management, and improved services delivery that Congress accepted in funding the SMP, are achieved. Alternatively, Congress may want to accept the judgment of SSA and its executive branch monitoring agencies as to whether current progress toward solving major implementation problems is acceptable, and implementation should proceed through the planned steps and scheduled milestones. This choice has a bearing on two immediate issues: a large SMP procurement in fiscal year 1987, and the proposal to make SSA an independent agency.

The SMP schedule calls for procurements to automate claims filing in field offices in early 1987. If implementation of SMP were proceeding satisfactorily, the timing of these acquisitions probably would not be controversial. The benefits of a modernized claims process, with improved service for the growing population of beneficiaries and greater productivity for SSA, would outweigh the cost of temporarily underused computer capacity while other procedures are automated. Unfortunately, there is conflicting evidence about the reality and pace of this progress, and whether SSA fully understands the nature of the technical hurdles that must still be surmounted. SSA has not convincingly demonstrated that it is on the way to solving its software and database problems, and some experts have questioned the advisability of proceeding with this or other procurements until such demonstration is made.

The decision about the procurement should be made in the overall context of the SMP and the desirable long-term goal, adopted in 1982, to modernize the SSA system. Analysis of costs and benefits of any procurement should include the effects of its timing on all aspects of SMP implementation. Proceeding with the procurement risks incurring the costs of unused communication and computer capacity while software is developed for automating additional field office services. On the other hand, procurement delay risks losing possible productivity gains in claims processing, as well as possible degradation in service, should staff reductions take place. It appears that the claims process could be automated, with considerable benefit to clients and the agency, while the software work continues. The database problems must be solved, regardless of the procurement decision. The immediate procurement issue should not deflect attention from, nor should it determine the course of actions related to the larger systems management problems in SSA.

Congress may wish to consider giving SSA a cautious "go-ahead" in conjunction with increased monitoring and close oversight, and insisting that broad corrective actions be taken over the next year to strengthen SSA's management control and its systems development capability. A second option is to stop SMP procurement and contracting, and to take advantage of this interval for congressional re-evaluation of the goal of providing SSA with state-of-the-art technological systems, and its feasibility, in the light of current priorities.[1] In this situation, however, some potential productivity gains may be foreclosed for the near future, and the commitment to and impetus of systems modernization may fall into disarray, and be difficult to recapture. A third option is to require each step in implementation to be justified in isolation; however, this involves Congress in a difficult process of micromanagement that may lose sight of the overall objectives of the SMP effort.

Some potential risks to the timely success of systems modernization are outside of SSA's control. The current pressure to realize productivity benefits by severe work force reductions before the modernized systems are ready, could lead to a return of the problems of 1978 to 1982, and thus discredit SMP and whatever progress has been made. Renewed instability of leadership and organizational restructuring could also delay progress and disrupt SSA's still fragile attempts to institutionalize advanced planning and to improve labor-management relations, both of which are essential to the success of systems modernization. These factors are as important to SMP success as is the immediate procurement issue.

The House of Representatives has voted for independent status for SSA; in part to reduce some of these risks. While this might buffer the systems modernization effort against some external pressures, it would not necessarily resolve the difficult questions about the most effective modes of congressional oversight and monitoring.

The Long-Range Implications of SSA Systems Modernization

SSA's ability to respond to congressionally mandated changes in benefits programs has already been improved, and will be strengthened further when it succeeds with software development and improvement. However, continuing automation of both operations and management functions—both in SSA and other Federal agencies—is likely to make effective congressional oversight more demanding and difficult. Information technologies can make it easier to select, manipulate, or obscure critical performance data, and the costs of failures in implementing and managing advanced systems may make it more tempting to do so. Evaluating management decisions and performance related to advanced technological systems increasingly requires specialized knowledge.

As the automation of SSA's operations proceeds, labor-management relations will inevitably be stressed. Displacement of some workers will occur, and there will be increasing need for retraining and relocation of other workers, and for reconsideration of personnel recruitment, retention, advancement, and compensation policies.

State-of-the-art information technology, by facilitating increased use of computer-matching techniques and the sharing of data about individuals with other organizations, and broadening access to data, will exacerbate present concerns about the privacy and security of social security information.

The findings of the report about the source of SSA's problems, why they were not resolved, and why their seriousness was not fully revealed by oversight and monitoring mechanisms before they became critical, have significant implications for other Federal agencies and for Congress. Many of the problems were found to stem from factors and forces that may affect all Federal agencies that become dependent on advanced information systems.

The report describes some mechanisms or actions that have been suggested for facilitating congressional oversight of SSA's systems modernization. They include independent agency status, broader and more frequent studies by congressional support organizations, integration of SSA oversight in one committee of each House, a stronger mandate for subcommittees overseeing government information technology decisions, and an external blue-ribbon advisory panel on government information technology decisions. The most promising of these options are those that could be generalized to apply to other Federal agencies with similar problems now or in the future.

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[1] This option was recommended by the General Accounting Office in its recent report on SSA automated data processing acquisitions dated August 1986.

Part I

An Overview

Chapter 1 summarizes the report of information technology management in the Social Security Administration (SSA), highlighting the conclusions of the study, and the issues related to SSA's **Systems Modernization Plan** and its implementation from 1982 through 1986 and beyond.

Chapter 1

SSA and Information Technology: Conclusions, Issues, and Options

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Chapter 1

SSA and Information Technology: Conclusions, Issues, and Options

In 1982, the Social Security Administration (SSA) began an effort to thoroughly modernize its data-handling systems, in order to ". . . avoid potential disruption of service through immediate improvement of critical system deficiencies, to restore integrity and public confidence, to improve productivity, and to close the technology gap"[1] that had developed over the last decade.

Projected to cost $500 million and take 5 years to carry SSA "from survival to state of the art," the SSA Systems Modernization Plan (SMP) was one of the most expensive civilian information projects ever undertaken. It has since become a "rolling" 5-year plan with projected costs currently estimated at nearly $1 billion. See figure 1.

This report of SSA and its SMP addresses the following questions:

- Why did SSA face "potential disruption of service" through "critical system deficiencies" in 1982?
- Why did continual congressional oversight and executive branch monitoring fail to prevent emerging problems from becoming critical?
- How sound are the basic strategies of SSA's Systems Modernization Plan?
- Is there evidence that the progress on SMP to date is reasonably satisfactory, and that it will achieve its objectives?
- How will SSA's systems modernization affect, or be affected by, several issues now before Congress such as the movement to give SSA independent agency status, the effort to reduce SSA's budget and the size of its work force, or the possibility of changes in social security programs, benefits, or eligibility determinations?

In addition, the report seeks to explore several broader questions that are addressed throughout the report:

- Are the problems that SSA had, and is having, generic problems that other Federal agencies are likely to face in managing information technology?
- What can be learned from SSA's experience that can be helpful in future adoption, use, and management of advanced systems for government operations?
- Will advanced information systems facilitate, or make more difficult, congressional oversight of executive agencies?
- Are there feasible strategies for making oversight more effective?

SUMMARY OF CONCLUSIONS

The necessity of modernizing SSA's information technology systems was beyond dispute, yet in the 4 years that SMP has been underway, it has never been free of criticism and controversy. There has been widespread questioning of the basic strategy of SMP and of certain critical choices that SSA made. There is serious doubt about how much progress has been made in systems modernization; and about whether SSA fully understands and is prepared to cope with some persistent problems, or has dealt, in an open and frank way,

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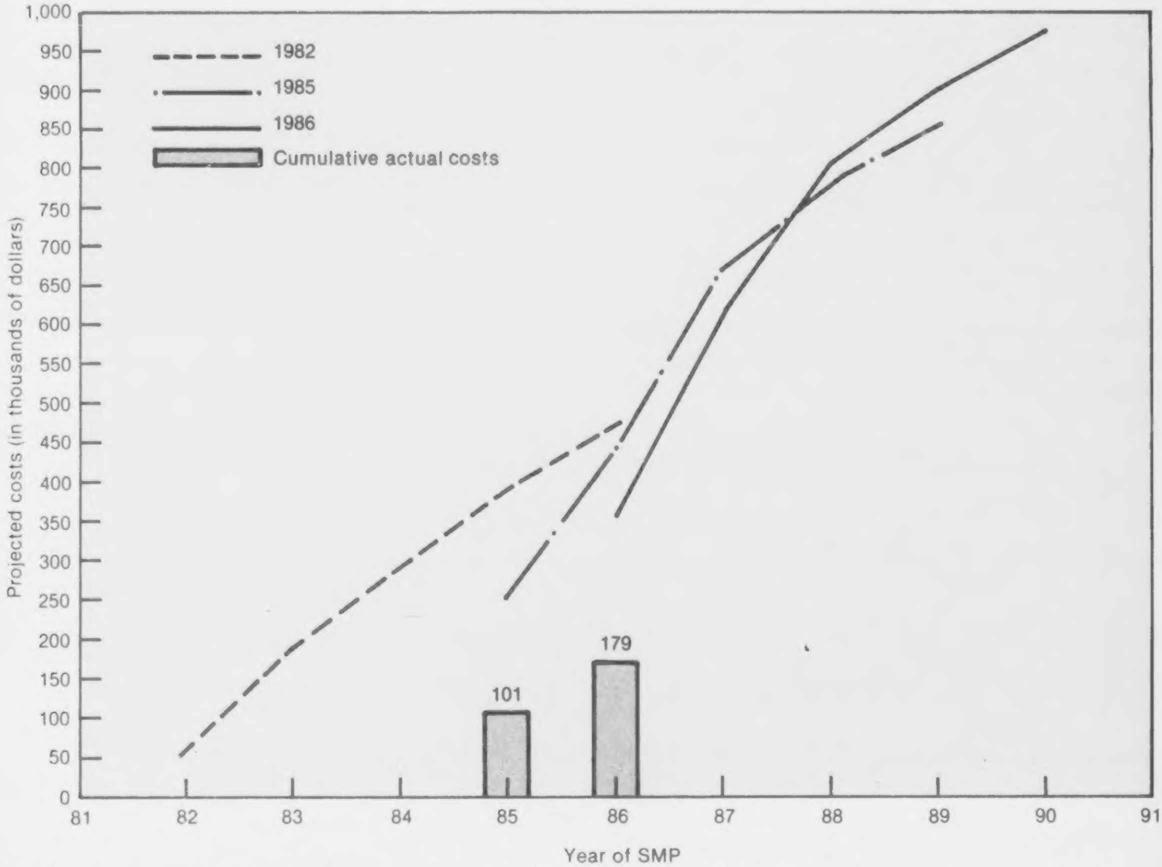
[1] This is an abbreviated quote from SSA's *Systems Modernization Plan: From Survival to State of the Art*, ch. 1, February 1982, pp. 18-19. Material in this chapter describing the Systems Modernization Plan and not otherwise attributed is drawn from SSA documents and discussions with SSA officials.

Figure 1.—Cumulative Projected Total Costs for the Systems Modernization Plan (SMP) for 1982, 1985, and 1986



SOURCES: U.S. Department of Health and Human Services, Social Security Administration, *Systems Modernization Plan: From Survival to State of the Art,* February 1982; U.S. Department of Health and Human Services, Social Security Administration, *Systems Modernization Plan: 1985 Update,* Publication No. 40-004, January 1985; U.S. Department of Health and Human Services, Social Security Administration, *SSA System Modernization Plan, 1986: Long-Range Strategic Plan,* Publication No. 40-004, October 1985.

with its oversight organizations in terms of these problems and SSA's plans to cope with them.

Some of the doubts about and criticisms of SSA's systems modernization plan can probably not be answered definitively. Both in the public sector and in the private sector, large organizations with complex data operations are still struggling to find the best ways to use advanced technology to maximum advantage. While many lessons have been learned from experience, experts can be found to attack or defend any strategy with plausible reasoning and with equal vehemence. There is no clear and indisputable "right" or "best" way to automate the operations of a large data-handling operation: there are several alternative approaches, each of which has some advantages and disadvantages. SSA's plan must be evaluated in that context.

The basic strategy of SSA's Systems Modernization Plan is in accord with accepted engineering practice; it is reasonable and defendble. **To reverse this strategy four years into the effort probably would be wasteful of investments already made, and alternative broad strategies suggested by critics would not necessarily provide any stronger guarantee of success. This conclusion does not however necessarily imply that SSA's performance in im-**

plementing the plan is satisfactory or that the objectives of the plan will be achieved. At a minimum, increased monitoring and close oversight are necessary if SSA is allowed to proceed according to its current schedule; but it is essential that decisions about specific SMP procurements be made in the context of the broad plan.

The success of SMP in meeting its reasonable objectives will depend not only on the basic soundness of the plan, but also on:

1. whether SSA has the technical competence to implement the plan,
2. whether SSA exercises good management in carrying out the plan, and
3. whether certain conditions are obtained at SSA at this critical stage in its implementation.

There are some serious questions about whether the progress toward implementation of the plan can be considered satisfactory. In some areas, the implementation of SMP is far behind schedule, and although SSA makes strong claims to have solved, or to be well on the way to solving, serious technical problems in achieving its goals, it has not been able to demonstrate to independent experts that this is the case. *There are disturbing signals that SSA either may not understand the seriousness of these problems, is relying on "solutions" that are likely not to work, or is covering up the seriousness and persistence of the problems.*

SSA appears to have just begun to develop some management procedures and mechanisms to improve its capability at advanced systems development, for example, to remove long-standing friction between the systems development and operations components of the organization, to improve the recruitment and training of systems personnel, and to use an innovative and constructive approach to labor-management relations. These management improvements, if they are developing as SSA officials describe, are still highly fragile. As this report is being completed, there has just been a change in SSA's top leadership. Whether this will strengthen or disrupt these promising developments, remains to be seen. A thorough reorganization of the agency could, for example, interrupt or destroy these still tenuous management improvements.

Other impending events that will affect the likelihood of success in systems modernization are largely out of SSA's control. For example, *the attempt to reap the anticipated benefits of increased productivity, in the form of severe work force reductions, before the systems are in place to provide these benefits could pose significant risks to continued progress.* The Administration is insisting on immediate reduction of SSA's work force. If SMP's promised increases in productivity are not yet in place to support such reductions (as they probably are not), any subsequent temporary expansion of the volume of work (e.g., implementing a legislatively mandated change in benefits or coverage) could again lead to huge backlogs, which could discredit SMP before it is completed, and would almost surely result in a breakdown of a promising but still embryonic joint agreement designed to reduce crippling labor-management tensions.

SSA's problems in data-handling built up slowly, but became evident when the agency was several times able to respond to congressional mandates only with extraordinary efforts and with long-lasting, deleterious aftereffects. For at least a decade, *SSA's frequently changing leadership was unable to solve chronic organizational problems, and the agency failed to communicate effectively these problems to Congress throughout several Administrations.*

Many of the problems that in the decade before 1982 drove SSA to the brink of crisis were common to many large organizations with similarly complex operations and rapidly growing workloads. In the case of SSA, however, they persisted and were exacerbated almost beyond the point of solution by, on the one hand, certain characteristics of the organization and

failures of its management, and on the other hand, by external constraints and pressures, such as frequent changes in organization and in its top leadership.

Government agencies are properly and necessarily subject to constraints, accountability requirements, and oversight that do not affect private sector organizations. These greatly complicate agencies' decisions about technology and forbid some routes to modernization that private sector organizations have found productive. In addition, governmental agencies are insulated against suffering the immediate marketplace penalties for bad decisions; this allows them at times to persevere in faulty management practices and to ignore or conceal emerging problems until they become intractable. The report indicates that in some aspects of systems modernization, SSA did this persistently in the 1970s and may well be doing it today.

The problems that SSA has demonstrated will be likely to afflict other government agencies as they adopt, and struggle to use, advanced information technologies.

A number of Federal agencies are like SSA in that they handle huge volumes of highly standardized data, deal with individuals directly, and are now absolutely dependent on information technology systems to perform their missions: the Internal Revenue Service, the Bureau of the Census, and the U.S. Treasury are obvious examples. They are vulnerable to the same pressures that caused SSA to fall behind technologically, and those that the agency encountered in modernizing and managing systems, to the extent that these are structural or generic problems.

Congressional oversight procedures did not detect or understand emerging problems in SSA—for reasons that involved the priorities of SSA, the Administration, and congressional committees themselves. Similar problems in making congressional oversight effective are almost certain to occur in the future, and to become progressively more troublesome. A defensiveness on the part of SSA career officials, described in other chapters of this report, appears to have contributed to this situation and still complicates attempts to understand SSA's problems. This defensiveness was extreme but is not unique to SSA. The highly technical decisions that must be made with regard to advanced computer systems pose special difficulties for most congressional oversight committees. Special mechanisms may be needed to facilitate oversight of major technological decisions by Federal agencies.

The issue of restoring SSA to the status of an independent agency is now before Congress; the House of Representatives has already passed a bill (H.R. 5050) to this effect. One of the reasons that has been put forward in advocating this action is to improve SSA's responsiveness to congressional policies related to systems modernization. Whether or not this action is advisable on other grounds, *independent status is unlikely to solve either SSA's systems development problems or problems with congressional oversight of that process.*

For long-term success in achieving systems modernization and allowing SSA to use information technology efficiently and effectively in carrying out its mission, a strong systems planning capability is crucial. SSA's effective planning horizon is limited to 5 years forward, and is focused on achieving the state of the art of *today's* technology, not on being at the leading edge of information-handling technology as it continues to develop rapidly. SSA officials have said that they do not want to be on the leading edge but rather in a position of average industry performance. This means, however, that in 20 years it may again be a decade behind current practice, unless it continually forecasts and monitors emerging technological capabilities with a view toward their future utilization.

There are several other areas in which Congress may wish to clarify its policies or priorities with regard to SSA practices; among these are safeguards for the privacy and integrity of client information. This report of the SSA's systems modernization efforts is intended to help in foreseeing and understanding those problems.

WHY SSA FACED POTENTIAL DISRUPTION OF SERVICE IN 1982

The first question addressed in the report is, "why did SSA face potential disruption of services . . . through critical system deficiencies" as it stated when announcing its Systems Modernization Plan in 1982. The reasons for these deficiencies bear on the extent to which such problems are unique to SSA or may be of more general governmental concern. The steps through which SSA moved toward service disruption will be briefly summarized below. (Part II of this report is a more detailed case history.)

Brief History of SSA and Information Technology

Three Decades of Healthy Progress

In its first few years, 1935 to 1939, SSA began to establish a reputation as a highly efficient and well-managed agency. It was able to recruit a well-qualified staff, set high standards for data security and privacy and for responsiveness to client needs, and maintain low administrative costs. SSA then enjoyed a high degree of autonomy. Its needs for data-handling equipment stretched or exceeded the limits of then available technology, but the agency was able to work closely with manufacturers to push the state of the art. Commissioners were experienced managers and maintained a good balance between attention to daily operations and insistence on long-range planning for technological development.

From 1940 to 1970 there was steady growth in SSA operations. Congressional support for social security programs had become broadly bipartisan. Programs were expanded and new programs were added; but as the volume of work expanded the work force grew proportionately, at least in the first two decades. SSA employment tended to be a lifetime career, and workers and managers had a strong shared commitment to the social programs for which the agency was responsible.

In 1946, SSA was placed within the Federal Security Administration; thereafter, it was headed by a single commissioner rather than a three-person board. A few years later, it became a component in the new and massive Department of Health, Education, and Welfare.

In the late 1950s and 1960s, as information technology steadily improved, SSA developed a special relationship with IBM, and worked closely with that company to adopt and adapt systems to fit its needs. This was in no way unusual, since IBM was then the clear leader in the field, and computer systems in most Federal agencies were predominantly IBM. SSA was a leader in use of information technology through much of this period, although as late as 1971, SSA operations, like those of other data-handling organizations, were still heavily paper-based.

Early Signals of Emerging Problems

After Public Law 89-306 ("the Brooks Act") was passed in 1965, it was clear that SSA's relationships with computer vendors and its methods of procurement would have to change. But by this time IBM had able competitors. Competitive procurement should not have caused major troubles. By the end of the 1960s, however, there were emerging but not fully recognized problems at SSA. By virtue of having been one of the first users of large computers, SSA also had the oldest system; it was no longer at the leading edge and would fall steadily farther behind. If new systems were not necessarily to be IBM equipment, there would be problems of compatibility. Software conversion and updating would be a growing necessity. Documentation of changes in the software would become more essential; but the importance of this had not been fully realized earlier, and as the software had been adapted to accommodate changes in benefits or eligibility determination procedures, these modifications had not been well documented.

Because SSA had been at the forefront of computer use, its system designers, managers, programmers, and analysts had to learn their craft on the job. People at SSA tended to stay there, and some allowed their skills to become obsolete. Because promotions were based on seniority, and because SSA no longer had state-of-the-art technology, it became difficult to make room for, or to attract, highly trained newcomers.

In the late 1960s and early 1970s, these and other emerging problems were not highly visible to Congress, and perhaps not even to SSA's top management. As the work force grew, labor-management relations inevitably became more complex. The training and orientation given to new workers was somewhat diluted and their commitment to the goals of social security programs was less personally and directly translatable into standards of performance and loyalty to the agency. In the mid-1960s, with the rapid growth in most employees' workload, conditions deteriorated, and there were signs of serious tension. After 1962, union membership and collective bargaining for Federal workers made labor-management problems more adversarial.

Beginning in 1968, there were several forced reductions in SSA's labor force, although the work had increased with the expanded social programs of the Great Society. The increased workload strained the operating efficiency of the agency and further stressed the workers, while recurring announcements of layoffs caused resentment and feelings of insecurity. However, growing use of computers allowed the work to be absorbed without serious disruptions or delays.

A Decade of Deepening Problems

During the 1970s, SSA's problems deepened and became intractable. From 1972 to 1981, 15 new laws made changes in retirement, survivors, and disabled insurance programs. Four of these made significant changes in entitlements and benefits. This often required extensive changes in coding and revisions in software. Repeatedly the time allowed between the passing of a law mandating changes and the time at which they were to go into effect proved to be inadequate. The changes could not be made in an orderly and efficient manner, and were accomplished only at the cost of heavy overtime for the workers, high error rates, and disruption of other activities (e.g., quality control, new software development, and above all, long-range planning). Backlogs became a recurrent problem.

Instability of leadership and repeated and incompleted reorganizations of the agency, perhaps intended to solve the problems, instead made them worse. Between 1973 and 1981, SSA had seven different commissioners or acting commissioners, with an average tenure of 1.1 years. There were four drastic reorganizations, none of them fully completed in the sense of establishing clear jurisdictional boundaries and program accountability before the next reorganization. In the course of these, the activities of the major social security programs were split apart and distributed between functional divisions of the agency; program coherence was lost and performance measures were obscured. Advanced systems planning was fragmented, its professional resources drained to bolster over-stretched and failing operations; finally advanced planning was almost completely discontinued. Mechanisms for decisionmaking and for review and control of technology procurements, which had been institutionally separated, were merged so that important checks and controls were lost.

In the larger world, it was increasingly recognized that software development, rather than advances in hardware, was the key to the effectiveness of future computer systems. In this area SSA was now falling further and further behind. The complexity of its operations and the frequent changes in procedures that were necessary required frequent modifications of codes and software programs, but these were done piecemeal and under pressure, with little attention to uniformity, standards, documentation, or knowledge of the just beginning discipline of software engineering.

Promotion by seniority for systems personnel was by now taking its toll. The long tenure of SSA upper managers carried with it experience, loyalty, and dedication to the mission that was SSA's strength, but the managers also developed a deep defensiveness and a suspicion of both consultants and new administrators who criticized established procedures or tried to introduce management innovations.

The passage of the Supplemental Security Income (SSI) Program, at the end of 1972, evoked a crisis—still spoken of at SSA as a disaster—that made the agency's problems only too visible. This program was very different from other SSA programs, although the differences were not widely recognized at the time. It involved much greater interaction between SSA service representatives and clients, often under conditions of distress and urgency, and these interactions often took on the character of prolonged negotiations, or became contentious and adversarial.

SSA had two planning groups studying SSI proposals before Congress passed the bill, but there was considerable doubt until the last moment that it would pass, and in any case the planners had no resources to do more than minimal paper studies. After the bill passed, SSA had 14 months to get ready. At this point it chose to put in place a new telecommunication system to link service representatives with headquarters. There were only one or two terminals per office, the systems failed frequently, and the communications traffic exceeded expectations and soon saturated the communication lines. The communication system became a bottleneck in SSI operations rather than a facilitator.

Moreover, the number of people trained to operate the system and to provide client services was grossly inadequate. Long lines of clients formed, waited for hours, and were sent home to come again. Huge backlogs developed. SSA's reputation and public relations suffered severe damage, and its chronic problems were now visible to Congress.

Congress had not anticipated this outcome, and was surprised and indignant. Congressional oversight committees blamed SSA for poor technological decisionmaking, for misestimating the resource requirements of the new program, or for failing to inform Congress of the impending crisis. They suspected that SSA had been prevented from making its problems and resource needs known by its parent agency and the Office of Management and Budget (OMB), whose overriding priority was to reduce SSA's work force and budget. Employees of SSA say that agency officials had repeatedly warned the Administration and, indirectly at least, Congress that the preparation time and the work force for the new program would prove inadequate. All parties to the debacle agree that the oversight process had somehow failed to reveal the extent of SSA's problems in meeting congressional mandates, and those problems had become intractable.

The Systems Modernization Plan introduced in 1982 was designed to solve these problems. (The progress that SSA has made since then is discussed in ch. 2.) Neither SSA's problems, nor severe criticism of the agency in Congress and elsewhere, has disappeared. Stringent enforcement of the Disability Amendments Act of 1980 and the Debt Collection Act of 1982 brought SSA strong criticism. Pressure to reduce the SSA work force troubles its employees. There are many concerns about the agency's ability to respond to future congressional mandates for changes in its programs or procedures.

Underlying Factors in SSA's Critical Systems Deficiency

Problems Common to Large Data-Handling Organizations

From this brief overview and more detailed discussions in Part III, broad factors that contributed to SSA's nearly disastrous situation can be identified. Some were problems to which many private sector organizations had also fallen victim. The restructuring of the computer industry in the 1960s had caused widespread confusion and floundering in systems planning.

SSA's problem was not that its computers were "old" or "obsolete." It was that the workload had become too large, too complex, and too dependent on automated processing to be handled by SSA's existing work force with existing technology. In this situation, every addition to the workload became a potential crisis. Information processing was:

- pieced together, program by program, with manual handling and mechanical flow of data in between automated steps, with no agencywide planning or designing of a system that could allow the work to flow smoothly, and little backup for systems that "went down" when the workload was heaviest;
- the computer systems were driven by heavily patched, inefficient software, with years' of changes and revisions that were poorly documented; and
- the data in 50 years of SSA files was categorized and recorded variably and unsystematically, with data definitions that differed across files; there was no "corporate (agency) database."

Advanced computer systems cost millions of dollars and several years to procure and implement. These investments cannot be lightly abandoned. Continuing modernization of hardware requires continuing software upgrading and conversion. When technological capabilities are improving rapidly, the leaders in a field, having sunk large costs, may be overtaken and left behind by more recent adopters of the technology. Government officials are not as free to take risks as are corporate entrepreneurs; nor can they independently undertake to raise capital for new ventures on the gamble that this will pay off in the marketplace. Thus Federal agencies are particularly vulnerable to falling behind the state of the art in technology.

The greatest management failure at SSA was lack of planning and advanced development. Professional competence in computer technology was scarce and had to be devoted to solving immediate operational problems; the budget did not provide adequate resources for long-term systems development; top-level executive officers, who were not technologically sophisticated, did not insist on its importance; and political decisionmakers did not want to encourage demands.

Special Problems for Federal Agencies

Box A summarizes some conclusions from a series of OTA assessments of *Federal Government Information Technology*.[2] This special report on the Social Security Administration found that many of the generic problems identified in these earlier studies could be observed in this agency. Many of the Social Security Administration's problems are not particular to it, but typical of problems in large Federal Government organizations. The conclusions in box A were based on cross-cutting examination of many Federal agencies, but can also be read as a diagnosis of SSA problems in information technology management.

Excessive Instability of Leadership.—While much of the SSA work force, up through the levels of middle management, suffered from a lack of "new blood," the top level of management was continually changing. Commissioners are political appointees; in recent years they came and went almost yearly. Most had little understanding of advanced technology resource needs and constraints, or technology-oriented management, but sought to gain control by reorganizing the agency.

Frequent, drastic reorganizations broke up the earlier coherence and accountability of major programs, but failed to provide what may have been better—a rational structure based on a redesigned work flow and technology-based functions. There were no organization-wide systems or system development planning, because operations and systems development

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[2] U.S. Congress, Office of Technology Assessment, *Electronic Surveillance and Civil Liberties* (Washington, DC: U.S. Government Printing Office, October 1985); *Management, Security, and Congressional Oversight* (Washington, DC: U.S. Government Printing Office, February 1986); *Electronic Record Systems and Individual Privacy* (Washington, DC: U.S. Government Printing Office, June 1986). Conclusions in box A are quoted or abstracted from *Management, Security, and Congressional Oversight*, pp. 1-5.

Box A.—General Problems in Federal Government Information Technology and Information Policy As Identified in Previous OTA Assessments

Strategic Planning: Failure to:
- include strategic as well as operational planning in 5-year plans;
- identify innovative opportunities for use of information technology;
- connect planning effectively to implementation;
- involve users, clients, and the interested public in the planning process;
- explicitly consider the implications of information technology use for protection of data security and privacy; and
- have an effective vision of the future, with strategies for using new technology to further government missions.

Information Availability and Quality
- There are serious deficiencies in the scope and quality of information available to Congress and to agencies themselves, which can hamper effective congressional oversight and agency decisionmaking. There is a need to specify the types of information that should be reported to assist oversight of information technology, and to strengthen data quality standards and procedures.

Innovation
- Where there are examples of agency innovation, such as use of electronic mail, videoconferencing, and computer-based decisionmaking, the exchange of this experience and learning with other agencies is irregular or nonexistent. Many agencies view innovations as too risky to try.

Procurement
- Government information technology procurement is subject to multiple and sometimes conflicting efforts to simultaneously expedite the procurement process (e.g, through General Services Administration's delegation of procurement authority), increase the level of competition (e.g., the Competition in Contracting Act), and more clearly demonstrate a significant return on investment in information technology (as now required by OMB).
- The "success" of procurement is closely tied to the government's ability to plan and define technology needs and to match technology to those needs. There still appears to be a need for: better training of procurement staff, greater senior management involvement in and understanding of the planning and procurement process, improved mechanisms to exchange procurement experience and learning, and possibly a procurement and management troubleshooting team to assist with serious trouble spots.

Information Resources Management (IRM)
- This concept was intended to bring together previously disparate functions—such as computers, telecommunications, office automation, and the like—and to establish the importance of information as a resource. Actual implementation of IRM varies widely and has been only partially or minimally implemented in many agencies.
- IRM is essential for large, long-term investments in equipment and its related training and recruitment demands. Chief executives are not in control long enough to realize the return on investment in resources spent for long-range planning and development.

were constantly forced to compete for professional resources and management attention, and because reorganizations were generally not completed and "set," before a new commissioner and his team took over.

Private sector organizations had similar problems. SSA's problems were made more difficult by the imperatives and constraints that are special to public sector organizations. SSA's performance in coping with technological change in the face of these necessary governmental rules was particularly poor; but the explanation need not involve conspiracy, malfeasance, or even special ineptitude. These pitfalls will continue to beset governmental agencies as they attempt to reap the benefits offered by advanced information systems.[1]

In some cases, new commissioners arrived with a political directive (i.e., immediate budget reduction) that had to take priority over finding long-term solutions to chronic operational problems or improving service delivery. In addition, the scale of SSA operations and the extent to which they had become dependent on technological systems made it difficult for new leaders to understand SSA's problems quickly. This was compounded by the defensiveness of the long-tenured middle managers. Committed to "getting the checks out on time" and barely able to cope with growing backlogs, many of them feared any innovation, seeing it as carrying a risk of disrupting daily operations.

Lack of Control Over Changes in Its Workload and Commitment of Resources.—Corporations—if well managed—consider many factors before seeking a greater market, offering new services, or making significant changes in their operations. They pay particular attention to the timing and to the manpower, skills, and equipment that will be required. Often this analysis is made easier by studying the experience of similar or competing organizations. For SSA, assumption of new programs, provision of new services, and changes in benefits and entitlements are mandated by Congress. In government there are always at least three sets of actors in this situation: Congress, which mandates changes in mission and responsibility; the agency, responsible for performance; and the Administration, which can to some extent constrain the flow of resources, and to a large extent control the communication to Congress of resource needs. An agency's spokesman to Congress—its chief executive officer—effectively represents the Administration, rather than the agency.

Lack of Control Over Systems Procurement.—Competitive procurement became a serious problem chiefly because SSA had been accustomed to working closely with the vendor to develop systems tailored to its needs, did not clearly understand its technological requirements, and already was struggling with software loaded with poorly documented patches. By the time competitive procurement laws were passed, technological choices were broad, the computer manufacturing industry offered many alternative systems and vendors; there were many large computer-using organizations whose needs provided the stimulus for further technological innovation. SSA's poor procurement procedures rather than the legal requirements for maximum competition caused it serious troubles and opened the way both for defective systems and for fraud and abuse by SSA officials.

Nevertheless, the ability to schedule procurements at the best time for the organization, to carry them through quickly, to choose without constraints, and to gamble on innovative but unproven technology, gives private sector organizations a large advantage over government agencies in making technological choices.

Impatience in Collecting the Return on Investment.—Putting in place radically different technology for carrying out operations requires adjustment of the flow of work, changes in internal jurisdictions, and acquisition of a skilled work force and management team. Attempts to grasp the benefits too quickly—to sharply cut labor costs before the automation is ready to pick up the load—can lead to overloads and disruptions that discredit the systems and undermine management's commitment to the technology. The expectation that this will happen at SSA is now causing renewed resistance to and criticism of the SMP both within SSA and in oversight organizations.

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[1] For example, the Internal Revenue Service had serious troubles with its 1985 tax processing: a contractor review (according to *Computerworld*, which obtained the report from a congressional committee), said that IRS lacks a strategic plan, and its processing system is "inefficient, fragmented, and difficult to maintain." Mitch Betts, "IRS Systems Need Revamp, Auditors Say," *Computerworld*, Mar. 24, 1986, p. 1.

WHY MONITORING AND OVERSIGHT FAILED TO CORRECT SSA's PROBLEMS

During the 1960s and 1970s, SSA was progressively less able to respond to congressional mandates without herculean efforts, resulting in large backlogs, high error rates, deteriorating cost-effectiveness, and worsening workplace conditions. Repeatedly, congressional oversight committees were unpleasantly surprised by these outcomes, as revealed in later hearings. Yet oversight mechanisms, during this time, had been exercised diligently. Several factors contributed to these unpleasant surprises:

- *Differences in priorities between Congress, the Administration, and SSA itself constrained SSA communication of resource needs.*

  The White House and both Houses of Congress have been controlled by the same party for only 4 of the last 18 years. Administration constraints on the budget sometimes overrode estimates of the number of man hours necessary to make changes that Congress mandated, whether the Administration supported or opposed those legislative initiatives. Thus in 1972, the overwhelming demands that the Supplemental Security Insurance Program would place on SSA staff were not clearly communicated to Congress, although enough analysis had been done within SSA to make clear that new and more time-consuming ways of dealing with clients would be necessary.

  In 1982, both the Administration and Congress supported the large investment in SMP but with differing perspectives on its justification and expectations of its outcomes. The Administration supported automation as a means of increasing productivity and trimming the Federal labor force. Many Members of Congress give greater emphasis to improved responsiveness to clients.

  The way in which SMP was justified to congressional oversight committees in 1982 illustrates a problem that may occur frequently. The commissioner and his aides presented in documents and several hearings, a dramatically strong picture of SSA's "crisis" in operations. Congress had not heard such strong statements in the past, and heard them in 1982 only after an internal struggle at SSA. Some SSA middle and upper level managers then disputed (and still dispute with some bitterness) the accuracy of these statements—either because the statements were exaggerated, or from reluctance to reveal past shortcomings, or to protect their power base within the agency.

  All information that congressional oversight committees receive is of necessity affected by the political objectives of the Administration, and by the attention and concerns of the congressional committee that poses, or fails to pose, crucial questions to the responsible officials.

- *Conflicting priorities among oversight committees further obscured SSA's developing problems.*

  Oversight of SSA is shared by several committees in both the House and Senate. Appropriations committees have one set of concerns—accountability and efficiency; other committees focus on social programs and the special concerns of the aging or of disabled workers; others are chiefly concerned with competitiveness in procurements. In addition, since 1981 the House and Senate have been led by different parties, which emphasizes differences in priorities in guidance to SSA. SSA officials repeatedly assured each committee that the agency was attempting to respond to its chief concerns, without much discussion of the conflicting directives that this implied.

- *Alternative channels of communication failed to reveal the cumulative, interactive, and long-range nature of emerging problems.*

  GAO performed scores of studies of SSA for various congressional committees during this period. Most addressed specific, narrowly framed questions posed by the committees, usually having to do with technical performance or compliance with a particular law. It was difficult for any one person—even by reading all of the reports—to get an integrated, coherent picture of the situation that was steadily developing. (GAO's new series of agency management reviews takes a more integrated approach.)

Special studies by national commissions focused on the viability of the social security Trust Fund and did not probe SSA management issues; others (such as the Grace Commission and the National Academy of Public Administration) looked at management issues but did not give great attention to quality of services or to the long-range future.

- *SSA officials themselves had little motivation to call attention to accumulating problems.*

Congress does not confine its attention in hearings to the Commissioner. It heard from many other SSA officials or former officials, vendors, and outside experts during this time. There are also less formal channels of communication between bureaucrats and Congress. SSA officials who testified were nevertheless either political appointees or under their control, and so inclined not to dispute the Administration position. Those who held positions in operations and those who held positions in systems development, moreover, often lacked a comprehensive or disinterested view of the problems that were developing. Some others who appeared at hearings either had no credible source of information about SSA's internal problems or (especially vendors or potential contractors) had a vested interest in possible congressional actions.

- *Members of Congress and the staff of most oversight committees lacked the specialized expertise to challenge statements about advanced data-processing capabilities, options, or resource requirements.*

Most congressional oversight committees do not have either Members or staff with the specialized training and experience to fully understand or challenge what they are told about the increasingly complex and esoteric field of advanced information systems. Experts themselves disagree on many critical issues of design, capabilities, choice, implementation, management, and lifecycle costs; and few experts can discuss these questions in jargon-free language understandable to the nonspecialist. Staff members who have made themselves expert on one aspect (such as competition in procurement, or systems capabilities) may still not be experienced in problems of management. Relatively few are able to ask hard questions about the likely course of technological development over the next 10 years. Thus, it is increasingly likely that many important questions about long-range return on public investments will go unasked by Congress and thankfully unanswered by government agencies.

- *SSA's own estimates may have been unreliable.*

Though SSA people say that their requests for resources were repeatedly cut by the Department of Health and Human Services or OMB before reaching Congress, these estimates of requirements were themselves often the focus of dispute between operations officials, systems development people, and the Commissioner's office; it is not clear whether they were credible projections.

As Federal agencies become more dependent on large computer systems both for operations and for internal administration, critical information that Congress needs for effective oversight will more and more be embedded in large databases. Management information systems can be made to extract, combine, manipulate, and format data to produce performance measures, accounting categories, benchmarks, and trend projections tailored to almost any purpose. The temptation to present such information "in the best possible light" (or, according to purpose, in the worst possible light) has always existed; but computers can make it easier to get away with it by removing such processing a few steps further from easy perusal, everyday experience and plain common sense. At the same time, the motivation to conceal mistakes or failures is increased by the high stakes riding on investment in systems that promise high, but delayed, return on investment. It will be more and more difficult for most Congressmen and Congresswomen to challenge what they are told by agency officials about their technological choices and problems.

THE BASIC STRATEGY OF SSA's SYSTEMS MODERNIZATION PLAN IS SOUND

Another question addressed by this report is the soundness of the basic strategy of SMP. That strategy is:

1. *To Upgrade Computer Capacity:* To consolidate SSA's scattered computing systems and sites, greatly increase its total computer capacity, acquire more modern computers, develop a local network for high-speed data transfers, and acquire better peripheral equipment.
2. *To Integrate Its Database:* To rationalize and integrate files into an SSA database, by moving files onto disk storage, achieving direct (random) access to data, developing an overall "database architecture," and establishing a data dictionary to standardize the definition and form of separate units of data.
3. *To Institute Modern Techniques of Software Engineering:* To retain and upgrade as much as possible existing software, rewriting as much code as necessary; enforce consistent standards for all future software; improve and modernize all software documentation (reference manuals, user and training manuals, records of changes); develop new software applications.
4. *To Build a Data-Communications Utility:* To re-engineer and consolidate three major telecommunications networks into a modern, expanded conduit for two-way transmission of data and interactive communications between service representatives in the field offices and the headquarters processing operations.
5. *To Add Automated Management Tools:* To these primary goals were added, somewhat later, the development of automated techniques for managing and scheduling computer operations, and development of information systems for use in management and administration.

Most elements of this strategy are noncontroversial, but there are several points at which the strategy has been questioned, as is discussed in more detail in chapter 2. One debate centers on whether centralization of processing was a sound choice; the alternative is distribution of data-processing operations to regional centers. A second critical question is whether SSA should have bought or developed all new software, rather than choosing to preserve, modify, or rewrite millions of lines of code. (In practice, SSA now appears to be taking a middle course, rewriting some code and developing new software to modernize some operations.)

The questions and criticisms regarding basic SMP decisions are serious ones, but they do not have definitive "right" answers to which all experts can agree—in general or with regard to a specific organization such as SSA. *In terms of the basic SMP strategy, the choices that SSA has made may not be demonstrably the "best" choices but they are reasonable, in accord with well-established engineering practices, and defendable.* There is no guarantee that alternative choices or strategies, urged or implied by critics, would be more assured of long-range success or involve fewer problems or risks, or indeed fewer doubts and criticisms.

The main thrust of SMP strategy is to produce first a modernized claims process, with service representatives in field offices using interactive terminals to access SSA's headquarters' database to answer the clients' questions and transmit an application to headquarters for final processing. Other program procedures and management activities will also be automated as the plan proceeds. It can be argued that SSA should be looking much further ahead at developing technological capabilities and new ways of accomplishing its mission, rather than automating today's procedures with today's technology. This, however, involves a degree of innovation, and perhaps risk-taking, that few government agencies are willing or able to assume.

Substantial progress has been made in some areas of the SMP and there have already been large expenditures of time and effort which should show results in the near future. *To require SSA to begin again with a different strategy does not appear to be justified given the uncertain strength of the critical arguments.*

To conclude that the basic strategy is sound and should not be abandoned, however, does not necessarily mean that SSA can and will carry the systems modernization plan to a successful conclusion. Neither will it answer the broader question of how long-range technology planning and development—which will always be beset by uncertainty and risk—can best be evaluated in ways that are both useful to Congress and supportive rather than threatening to public servants with a difficult mission to perform.

What is needed is a mechanism or mechanisms for providing both agency officials and Congress with an independent and disinterested source of expert advice and evaluation, separate from monitoring and investigatory functions and also apart from both regulatory responsibilities and political objectives. While there would often be a lack of consensus among such expert advisors, the range of options available for consideration by agencies and by Congress would possibly be broadened and the relative advantages and disadvantages of the options clarified before choices are made. Such mechanisms already exist in the several congressional support agencies, but their assistance is often sought after basic decisions have been made and implemented. Also, since they are located within the legislative branch, their assistance and advice is usually not available in helping agencies frame action proposals to be put forward to the Administration or to Congress. One alternative is to create new mechanisms for this kind of public service. Some possibilities are outlined in the options section of this chapter.

CONFLICTING EVIDENCE ON PROGRESS IN SYSTEMS MODERNIZATION

There appear to be serious implementation problems to which SSA—in spite of strong claims of accelerating progress—does not yet appear to have a credible solution. Denial that these problems exist, or unsubstantiated assertions that they have been solved (in ways that to outside experts are not clear or convincing) *leave considerable room for doubt that SSA understands its technical difficulties or is addressing them adequately.* For example, while SSA proceeds with hardware procurement and upgrading, it consistently downplays the problems it is having in defining a database architecture and making decisions about database integration and management. Only persistent challenges to the statements of SSA officials and comparison of those statements with information gleaned from workers, contractors, and monitors, reveal the existence of some of SSA's persistent, unresolved technical problems. GAO's forthcoming management review, based on examination of records not directly available to other congressional support organizations, may answer at least some of the questions raised in this report about the adequacy of SSA response to technical problem areas and the amount of sound progress that has been made. (See table 1.) If GAO confirms the apparent gaps between SSA's official statements and the degree to which SMP objectives are being realized, this will underscore the increasing difficulties in monitoring highly technology-dependent government operations.

As of the end of fiscal year 1986, it appears that about 20 percent of SMP's currently projected costs have been expended. Major procurements for the SMP, especially for placing the interactive data communication terminals in field offices, will occur in fiscal years 1987 and 1988. Some SSA critics say that before such steps are taken, Congress should insist on a complete reexamination of the assumptions and strategy of the SMP with a view to aiming it in radically different directions, or formulating a quite different plan. At a minimum, they say, the procurement of 22,000 to 39,000 interactive terminals should not be done this calendar year as scheduled—instead, terminals should be phased in over the next 2 to 5 years, or the procurement should wait until all field office services are redesigned and automated. Even though there are no convincing arguments for reversing SMP's basic strategy at this stage, it is not certain that SSA is making satisfactory progress in development of software; **it would not be unreasonable to move more slowly in making major procurements until there is proof of acceptable progress in all areas. This decision, however, should be made in the light of its effect on SMP as a whole. To stop a pivotal SMP procurement on the grounds that the 1974-82 operational crisis has been surmounted would effectively be a rejection of the concept and objectives of systems modernization.**

The most unequivocal progress in implementing SMP has been made in upgrading the capacity of large primary computer systems. Major programmatic systems computers have been upgraded and "mean-time to failure" increased from 270 hours to 19,000 hours. Telecommunication processors and some decision support systems have been installed. Major files have been moved from tape storage to disk storage. The six Program Service Centers are still using very old, too small computers and a procurement award for their replacement has been held up by a challenge under the Competition in Contracting Law. In general, however, the *capacity upgrade program*, which will account for about 24 percent of SMP expenditures, is approximately on schedule, with other procurements to be completed this year.

The *software engineering program* has had serious problems and is behind schedule. SSA claims to have completed essential early steps: definition of its functional requirements for data-handling and software applications, developing software engineering standards, and preparing a basic Software Engineering Technology manual. The agency says that it is making a strong effort to enforce new tools and standards for software development.

Some new software systems and applications have been put in place. SSA apparently judiciously abandoned vague promises to rewrite all old code, but software improvement has begun. SSA is, however, still far from having made its existing software "maintainable and transferable," as was to have been achieved by this time.

There is evidence that in some areas the functional requirements are not well enough developed to be an effective guide to systems redesign, and that use of software engineering tools and standards is not yet stringently enforced. Software will not be ready for full and efficient use of the new interactive terminals being procured for field offices for several years.

About 21 percent of total SMP projected costs are allocated to the software engineering technology program; expenditures in this program have been running somewhat ahead of projections.

Database integration is also far behind schedule; SSA now says that by 1987 this part

Table 1.—Major Reported Accomplishments of the SSA's Systems Modernization Plan in Its First 4 Years and Future Milestones by Specific Program Areas

Accomplishments[a]	Transition to state of the art
Software engineering program:	
• Piloting a modernized claims system at two district offices • Initiated functional requirements for LAGs • Completed operational software improvements • Designed new debt management system • Began piloting critical payment SET • Designed AWR • Established PDTF/TTSF	• Design, develop, and implement LAG software • Upgrade SET • Continue software improvement • Implement claims modernization nationwide
Database integration program:	
• Implemented nationwide, on-line query capability on several major master files for district offices • Converted major files from tape to disk storage • Implemented data administration tool • Began piloting target database architecture • Initiated data purification • Initiated database support for LAGs	• Implement on-line omnibus query capability on all major master files • Complete data purification through verification and validation • Develop and implement database architecture • Provide database support for LAGs
Data communications utility program:	
• Continued with procurements of DCU network and terminals • Replaced SSADARS host computers • Upgraded telecommunications lines and software • Completed general DCU design • Planned DCU and TAP implementation	• Implement DCU backbone network nationwide • Acquire and install new terminals for district offices • Engineer future network components and expanded capabilities
Capacity upgrade program:	
• Completed seven phases of DASD installation • Converted on-line, programmatic, and test systems to MVS/XA Operating System • Implemented local computing network and HYPERchannel facilities • Installed high-speed printers at Baltimore sites • Replaced programmatic and TTSF host computers	• Install new hardware at PSCs • Upgrade programmatic, telecommunications, and test capacity
System operations management program:	
• Implemented new tape management system • Increased job run frequency for critical system • Implemented automated job rerun capability • Improved offsite storage process	• Continue to institutionalize and enforce data center standards • Complete user service agreements • Expand use of automated tools to on-line and decision support systems • Complete NCC integrated control center • Modernize computer operations at PSCs • Implement on-line operating environment
Administrative/management information engineering program:	
• Established information center • Initiated office automation projects for SSA components • Initiated MID project to provide reliable management information for SSA • Initiated projects to define management information requirements for MID • Implemented end-user computing guidelines • Developed framework for an integrated MIS • Installed FAIMS database management system on the TTSF	• Implement new systems to provide reliable MIS • Increase office automation • Implement SSA's portions of FAIMS • Develop management information database architecture • Provide telecommunications support for management information

[a] The text raises questions about some of these accomplishments.

KEY: AWR —Annual Wage Reporting
DASD —Direct Access Storage Device
DCU —Data Communications Utility
FAIMS —Financial and Administrative Integrated Management System
LAG —Logical Application Groups
MID —Management Information Design
MIS —Management Information System
MVS —Multiple Virtual Storage
NCC —National Computer Center
PDTF —Program Development and Test Facility
PSCs —Program Service Centers
SET —Software Engineering Technology
SSADARS—SSA Data Acquisition and Response System
TAP —Terminals Acquisition Project
TTSF —Test and Time Sharing Facility
XA —Extended Architecture

SOURCE: U.S. Department of Health and Human Services, Social Security Administration, *SSA Systems Modernization Plan 1986: Long Range Strategic Plan*, Publication No. 40-004, October 1985.

of the implementation may be back in step. Some tasks have been accomplished. Master files have been transferred from magnetic tape to disk storage, and the number of tapes in use for storage has been significantly reduced. Field offices have been given limited access to the master data files through a file management and access system, although processing is still sequential, and random (direct) access to records is still beyond SSA capability. A data dictionary has been developed, but it will take years to rewrite all of the 50 years of records to make them fit the data dictionary categories and standards.

Real database integration is, however, still far in the future. SSA has still not settled on a database architecture, although the agency says that a "target" database architecture has been defined. This in turn further delays the rewriting of software. It is difficult to tell whether SSA has, in fact, made any significant progress toward real database integration. Recent statements that it has taken a big step toward solving the architecture problem by deciding to use an already available data management system appear to be almost meaningless on close examination.

This program was originally expected to spend about 14 percent of projected SMP costs; it appears so far to have accounted for about 4 percent of expenditures.

The *data communications utility program* appears to be about on schedule. Troublesome data transmission backlogs were greatly reduced during the first year of SMP by replacing the host computers, adding trunk lines, and upgrading telecommunications. The backlogs have now been eliminated. The design of the communications utility has been completed, and by early 1987 SSA plans to put over 22,000 interactive terminals in field offices, to modernize its claims process. The timing of this move is controversial; many critics argue that terminals cannot be used to full capacity for several years, and a full-scale procurement should not go forward at this time. The data communications development program has expended 7 percent of SMP costs to date, but will eventually account for about 28 percent.

In 1984 a new component was added to SMP, the *systems operation and management program*, to develop automated procedures for scheduling and managing major computer operations. It has already implemented automated job scheduling and several other applications, and is on schedule. This will account for less than 3 percent of SMP costs. Another element belatedly added to the plan is the *administrative/management information engineering program*, to develop management information systems and other administrative tools, and to encourage personal computer applications and use. This effort is one of the more advanced elements of SMP, although hardly avant-garde. Not including this element in the original SMP was a blunder that may have significantly increased the costs of the management information systems development. The program will probably account for about 20 percent of SMP costs.

SSA reports that the backlogs and high error rates that marked the crisis period have largely been overcome, that SMP has already significantly improved performance, and that the basic steps have been accomplished to allow continuing and steady progress in the later phases of SMP.

According to SSA, significant progress has been made in developing new mechanisms for strategic planning and for resolution of the persistent conflicts between operations and systems development personnel, through their mutual involvement in the systems modernization effort. There is said to be an active program of outreach to the systems users to further define changing functional requirements. The agency has expanded its training programs as it implements the SMP, and has recently recruited some senior computer systems experts. A joint agreement with the union was signed last year, which appeared at that time to hold great promise for improving labor-management relations.

One critical test of SSA's claims of improved management and resolution of internal conflicts over systems modernization will come during the next 6 to 9 months, as the claims modernization project is implemented. If these improvements are real, they are more hopeful signs of progress than acquisitions or quantitative measures of performance, because such management innovations would signal a change in SSA's organizational culture and behavior. Such changes are probably essential to the success of SMP.

There are, unfortunately, reports that these new mechanisms have already disappeared or gone dormant. The joint agreement with the union is being severely strained by SSA's official position with regard to work force reduction, and there is widespread disappointment with the present lack of activity in putting its provisions to practice. Since the announcement of a change in leadership of SSA, the expectation of another drastic reorganization has raised fears of a protracted period of uncertainty, confusion, and possible internal power struggles. The present organizational structure is probably far from ideal; however, it has the advantage of allowing for agencywide rather than program-by-program design of an automated work flow, and its continuation for a while could help avoid the disruption and turmoil caused by repeated reorganizations of SSA over the last decade. Assessment of the likelihood of progress in systems modernization in the near future must take into account these troublesome uncertainties.

Many critics of SMP are skeptical of SSA's ability to achieve its objectives. Some individuals inside and outside SSA and in monitoring organizations privately dispute some of SSA's claims of progress, say that bad news is being concealed, or suggest that performance indicators have been changed and, therefore, results of SMP (in terms of comparison with past performance) cannot be demonstrated. Such private comments may sometimes be based on biased judgments, or on obsolete information; progress of SMP has, if SSA claims are accepted, quickened in this fiscal year in spite of some unanticipated delays because of challenges under the Competition in Contracting Act.

Both SSA statements about progress or results and the statements of its critics are difficult to evaluate since those who do not have a vested interest to protect also do not have independent access to operational data or close familiarity with SSA's complicated tasks. GAO is now undertaking an extensive management study of SSA[4] that will provide another expert judgment; however, both GAO auditors and OTA assessors are in part dependent on information selected and presented by SSA.

The more fundamental difficulty for Congress, however, has been and will be the necessity of making judgments about complex technological strategies for which there are no categorically right or wrong answers and on which even computer experts disagree.

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[4] Recognizing that good management is essential to the effectiveness of a department or agency in achieving its mission, GAO in 1982 launched a new initiative, to perform reviews of the overall management of selected Federal agencies. These reviews are to facilitate effective congressional oversight by showing how breakdowns or problems in agency management structures and systems contribute to long-standing programmatic and administrative problems. The GAO management review of SSA is not yet complete.

THE EFFECTS OF SYSTEMS MODERNIZATION: CLOSELY RELATED ISSUES

Systems modernization is likely to affect and to be affected by a number of questions and issues now before Congress: suggested modifications in social security programs, independent status for the Social Security Administration, privatization of government services, Federal labor-management relations, and data privacy and security concerns. These are discussed briefly below, and in more detail in chapter 3.

SSA Responsiveness to Congressional Mandates

The ability of SSA to respond efficiently and quickly to congressional changes in programs, entitlements, and benefits has improved because of the elimination of backlogs of work, and should be further improved if the systems modernization plan meets its objectives. So far, however, the elimination of large backlogs and achievement of a smoother flow in daily operations has been made possible largely by the hardware improvements—the capacity upgrade. Significant further improvement probably depends on resolution of the technical difficulties with software development and database management, and redesign of post-entitlement systems. It is, therefore, possible that assignment of responsibility for large new programs (e.g., as support for immigration control measures) at this stage could complicate and delay implementation of some SMP steps by suddenly increasing its volume of operations, or requiring new data to be collected and managed. Some congressional sources have suggested a moratorium on legislative changes until SSA is closer to completion of its systems modernization, but this is probably not essential. The changes that appear most likely to be proposed over the next few years, according to congressional committee staffs, appear reasonably small and could probably be assimilated without the large backlogs that occurred in the 1970s.

Independent Status for SSA

The House of Representatives has (in July 1986) passed H.R. 5050, a bill to give SSA independent status, and similar proposals are expected to come before the Senate. Support for the measure comes from some who hope:

1. to give SSA more stability and continuity in leadership;
2. to facilitate congressional oversight of SSA by removing the "political filter" that they believe distorts communications with Congress;
3. to protect SSA from OMB work force reduction and privatization pressures; or
4. to prevent measures that they believe will adversely affect the quality of social security services, such as overly zealous attempts to cut disability rolls.

Stable, experienced leadership could contribute significantly to success in systems modernization, if that modernization is a high priority of the appointed leaders. Independent status might do relatively little to facilitate congressional oversight, because it has also been hampered by other factors, as described above, including SSA's own tendency to hide its problems. Independent status must necessarily be limited to a few agencies, yet most of the problems that SSA has had in managing information technology are likely to affect other government agencies as their information needs expand and as they first adopt new information systems. Congress can clearly not make all agencies that suffer from these problems—or from specific Administration directives—into independent agencies.

Systems modernization is thus not, in itself, an argument for giving SSA independent agency status. However, if Congress decides that Administration personnel and privatization directives are likely to disrupt SSA operations before systems modernization can be achieved, this option will become more attractive.

Privatization of or Contracting Out Government Operations

The Department of Health and Human Services has directed SSA to develop a plan for contracting-out the equivalent of 8,600 full-time positions, about 12 percent of its work force, in operations such as the processing of annual wage reports and running the National Computer Center (where central beneficiary records are maintained). Privatization of determination of disability status (now done by the States) has also been proposed. OMB, GSA, and GAO have found that privatization of some government services can result in significant cost-savings and improved services. But there are serious concerns to be considered in privatizing social security operations:

these include the additional risk to confidentiality and security of SSA's personal data on 160 million Americans; questions of public confidence in the fairness of eligibility and benefits determinations; the level of competition that could be expected; the large amounts of time and labor that would be necessary for contractors to learn and master SSA operations; possible disruptions from periodic recompeting of the contracts; the likelihood of conflicts of interest for many or most competent competitors; opportunities for fraud; additional difficulties of congressional oversight; and difficulties of contractually specifying a required level of quality of service.

An important question is whether privatization would reduce the return on investments already made in SSA's systems modernization. *Congress will want to consider carefully whether privatization initiatives are likely to prejudice the objectives that it has sought in supporting SMP, i.e., improved quality of services and equity as well as efficiency in use of public resources.*

The Work Force and Labor-Management Relations

Increasing tension between labor and management during the decade of mounting problems in the 1970s has worsened since 1982 with the threat of severe work force reductions. Employees and their union take the position that improved productivity should be translated into enhancement of services and better working conditions rather than immediate elimination of jobs.

SSA and the union recently agreed to a Joint Statement of Common Purpose toward labor-management relations. After a promising start, that agreement is now said by union sources to be breaking down. *Labor-management relations are likely to worsen if systems modernization is directed toward immediate labor force reduction.*

Privacy and Security Concerns

Systems modernization will facilitate and probably encourage data-sharing programs and computer-matching programs that have expanded under OMB directives and GAO recommendations. SSA is now considering their use for front-end verification of eligibility, which has not been done in the past. These activities are considered useful for elimination of waste and fraud, although SSA has not systematically evaluated their cost-effectiveness. There are, however, growing concerns about intrusions on personal privacy when data collected for many specific legitimate purposes is aggregated and used for other purposes, and/or shared with other Federal and State agencies.

Security measures for SSA's main computers and databanks have generally improved since 1982 with consolidation of processing activities in the National Computer Center and improved backup of files. SSA does not, however, have procedures and policies to assure privacy and security for data in personal computers. Opportunities for violations of privacy, for fraud, or for inadvertent loss of data will increase as SSA places interactive terminals in field offices and puts a new data communications utility into use. Although SSA plans to use standard techniques of restricted access, passwords, audit trails, etc., for protection, many of the planned control systems have not yet been developed.

Other new technologies which SSA is using or will use in the future, ranging from personal computers to satellite transmission and integrated services digital networks, will also increase the opportunities for unauthorized access to, misuse of, or theft and loss of data. SSA has done relatively little as yet to implement, or even plan for, privacy safeguards for some of these technologies.

Systems modernization will tend to intensify concerns about the privacy and security of SSA data.

OPTIONS FOR FACILITATING CONGRESSIONAL OVERSIGHT OF SYSTEMS MODERNIZATION

In spite of the attentions of a half-dozen congressional committees and frequent hearings, emerging problems were allowed to become chronic and Congress was repeatedly surprised by SSA's serious difficulties in implementing congressional mandates. At present, OTA has identified a large number of unanswered questions and unresolved issues about which there are strongly conflicting critical charges and SSA claims regarding SSA information systems development and management. There are disturbing signs that SSA's statements on some of these questions cannot be taken at face value. Some of these questions are in that area of uncertainty where there are no definitive answers and even experts may disagree among themselves. It is increasingly difficult for nonspecialists to challenge the actions or the statements of agency managers, who must both be given support in carrying out difficult assignments and be held accountable for their actions. New ways of supporting and assisting congressional committees in their difficult oversight role may be needed, including sources of advice and evaluation that are not associated with investigation, regulation, and assignment of blame for inevitable mistakes. At a minimum, Members of Congress and their staff are concerned that they have access to information about agency needs and agency problems. This information can be provided most easily by the agency, but is often filtered or distorted to fit executive branch policies and priorities. With particular regard to SSA, there are a number of options that address the oversight issue:

1. Independent agency status for SSA has been proposed as one approach to this problem, but it is likely to be at best only partially effective. Executive branch priorities have been only one factor in oversight problems; some of the trouble has come from inside SSA. Moreover, this solution is a special or limited answer that cannot be applied to all agencies that may present similar problems.
2. Increasing the number of GAO audits, or studies from other sources, is a second option. GAO audits and several national commissions have been invaluable in supporting congressional oversight but have not entirely solved the problem. National commission studies usually provide only a snapshot of the situation at a given time, and are in addition usually slow, costly, and necessarily rare events. GAO studies have in the past been technical and narrowly focused, responding to the specific perspective and concerns of the requesting committee or of the Administration, reflecting the fragmentation of oversight responsibilities. They thus tended to overlook intensifying interactions between problems, as well as the effects of one congressional directive or legislative requirement on other competing congressional concerns. GAO is however now undertaking a broader management study of SSA which will be available to Congress later in 1986, and will provide additional insight into current information technology management problems and progress.
3. Designation of one committee in each House, or a joint committee representing both Houses, for comprehensive oversight of the Social Security Administration is a third option. This would tend to simplify, integrate, and intensify oversight of the agency, and allow Members and staff to expand the attention they can give the agency and deepen their knowledge of its needs and problems. However, it might lose the benefit of different points of view and specialized knowledge that can be brought to bear by other committees.
4. A more tightly focused mandate for the subcommittees on government information technology management presently in each House is a fourth option. At present the responsibility for information technology is in each house combined with other, somewhat disparate responsibilities. A more tightly focused mandate would in-

crease the attention given to this subject. This would, however, tend to cause consideration of technological issues to be divorced from considerations of each agency's special mission, the quality of its services, and congressionally proposed changes in missions.

5. An external advisory body of nationally recognized experts on advanced information technology could be established to assist all oversight committees now concerned with Federal agencies that are becoming dependent on information technology to carry out their missions. For best use, this body of experts should not be charged with monitoring, investigation, or routine assessment, but should be available, staffed, and ready on a continuing basis to translate for Congress in discussions of technological issues and options, to evaluate agency and Administration positions on basic technological choices and strategies, and to alert Congress to technological trends that might offer alternatives. They could also assist Federal agencies in technology-related choices in an advisory and impartial way, and thus could provide a counterweight to Administration pressures for actions that are not realistic in terms of technological capabilities.

   Such a group could be located within an existing congressional support agency. This may however not be the best strategy, because:
   - it is difficult to attract into government service people of the prestige and standing that would make for greatest credibility, to assure them of independence, to give them the resources necessary to keep their expertise and their prestige at the desired high level; and
   - within a congressional agency, they would be viewed by the executive agencies as investigatory and threatening rather than as advisory and helpful.

   Thus a blue-ribbon panel, selected from industry and academia, with a small but highly expert staff, may be preferable.

Part II

The Systems Modernization Plan and Its Potential Effects

Chapter 2 describes the Social Security Administration's Systems Modernization Plan, discusses the status of its implementation, and identifies some persistent technical and management problems. It concludes that the plan is rational and defendable, but there are serious unanswered questions about the implementation of the plan. SSA does not appear to recognize the seriousness of some of these implementation problems, or has not been forthright in discussing them with monitors and oversight institutions.

Chapter 3 discusses the implications of systems modernization and further automation for SSA's relationships with Congress, SSA's employees and clients. It considers questions about the future status of SSA, including proposals to make it an independent agency, and to privatize some of its functions. Other public policy issues, such as the privacy and security of personal data processed by SSA, are discussed in relation to the SMP.

Chapter 4 highlights the increased need for comprehensive long-range planning within SSA, to define goals and priorities and thus provide a context and rationale for technological systems planning.

Chapter 2

The Status of Systems Modernization at SSA, 1986

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Chapter 2

The Status of Systems Modernization at SSA, 1986[1]

INTRODUCTION

Commissioner John Svahn, newly appointed,[2] began in 1981 to work out a strategic plan to develop modern information systems for the Social Security Administration's (SSA) data processing. A planning group was formed under his direct control, to guide the planning and its presentation to Congress.

The Systems Modernization Plan, hereafter referred to as SMP, was to be an integrated long-range plan for thoroughly upgrading SSA's data-handling operations, with new or improved software, hardware, and telecommunication systems and increased computer capacity. Unlike previous SSA systems development efforts, SMP would be an agencywide plan emphasizing integrated service to all programs and offices. In the recent past, work on improving systems had been done in specific SSA program areas, with little consideration for the fact that the district offices had to serve all of the programs.

SSA had always tended to automate on a project-by-project or program-by-program basis, which resulted in poor integration at the service delivery level. This had been institutionalized by the previous commissioner, who had adopted a "partitioning strategy" that segmented the several programmatic areas, redesigned them, and procured hardware for them separately. SMP explicitly rejected this approach.

The SMP also differed in other ways from earlier SSA practices. It was designed as a dynamic 5-year plan that would be reconceptualized yearly to account for new developments in technology. (The published 1982 plan, however, did not say explicitly that it would continue beyond the initial 5 years.) The plan provided explicitly for help from external expert consultants and contractors. The solicitation of vendors for a telecommunications upgrade (later won by Paradyne) was already underway; it was assumed that this would fit into the SMP to develop a "data communications utility," that is, an efficient conduit for transmission of data between headquarters and field offices or other points on an SSA network.

The 1982 SMP was focused almost entirely on delivery of services; internal administrative systems got little attention, and no provision was made for developing management information systems. These features were added to the plan later.

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[1] The material in this chapter (not otherwise attributed) is drawn from the 1982, 1984, 1985, and 1986 System Modernization Plan, and accompanying documents, provided by SSA; several briefings by top-level SSA officials in the Office of Systems and the Office of Operations; and written and oral response by SSA officials to OTA drafts or inquiries. This material was augmented by or compared with information gleaned from more than 65 interviews conducted by OTA and its contractors, with knowledgeable people both within and outside of SSA; congressional hearings and reports; reports of the General Accounting Office (GAO); and the transcript of an OTA workshop in which both SSA officials and advisors to OTA participated. The OTA contractor for this case study was The Educational Fund for Individual Liberties, New York City (Alan Westin and Kenneth Laudon, Principal Investigators).

[2] Commissioner Svahn was a former insurance company executive. From 1976 to 1979 he had, however, been employed by the firm of Deloitte Haskins & Sells (later a major subcontractor on SMP).

SMP's PRINCIPLES AND STRATEGY

At a cost of nearly $500 million (which by 1986 nearly doubled, to $990 million) SMP was one of the most expensive single civilian information systems projects ever undertaken. The plan set out "governing principles," which in reality are generalized aspirations:[1] immediate improvement to avoid disruption of service; improved client service; assured accountability and auditability; improved timeliness of service; improved productivity and management control; and closing of the technology gap (i.e., modern systems). Nine principles were to be followed—these are important elements or descriptors of the systems modernization strategy for purposes of evaluation:

1. improvements would be "incremental and evolutionary";
2. systems modernization would be kept separate from operation and maintenance of existing systems;
3. a systems integration contractor would assure project continuity;
4. "proven state-of-the-art technology" would be used;
5. the effort would "build on existing systems" to salvage past investments and minimize risks;
6. design changes would be limited to "critical, user-defined needs";
7. system architecture would be reconfigured to take "full advantage of advanced technology";
8. acquisitions would be planned to permit technology upgrading within a "code compatible architecture"; and
9. a single group would plan, manage, and operate the modernization program.

This was a conservative strategy, following well-established systems engineering practice, and designed to satisfy SSA's critics in Congress and elsewhere, while not disturbing its supporters. SSA's Office of Advanced Systems, before it was abolished in 1979, had argued for starting fresh, with all new procedures and systems, but SMP rejected this approach.

The plan calls for salvaging prior investments by building on existing systems. This means that SSA will look for immediate short-term solutions that are compatible with long-range goals. SSA has been criticized in the past *both* for patchwork fixes to problems rather than system redesign, and for redesigns that failed to take into account the critical prerequisites for an orderly transition.

In the past, the same personnel had responsibilities for both systems development and operations, and there was seldom time for modernization planning. A single organizational unit, separate from operations, would now be responsible for planning, management, and control of the modernization program.

A system integration contractor (Electronic Data Systems of Dallas [EDS]) was hired to provide continuity throughout the duration of the plan, and to coordinate across SMP program areas. Redirection of development efforts in midstream and frequent turnover at the top had hampered past efforts.

SSA would not be able to work with manufacturers to develop innovative systems designed to meet its needs, as it could do in its first decades (see ch. 5). SMP called for proven state-of-the-art systems from industry. This meant that no "unproven technology" would be used. This strategy was reinforced after SSA suffered from its experience with a telecommunications system upgrade procurement (the Paradyne contract, to be described in ch. 6). The phrase "state of the art," on the other hand, was a signal that SSA would use contemporary software development technology, and structure and document software in accordance with modern standards.

The plan limited design changes to "critical, user-defined needs," but said that systems architecture would be reconfigured to take full advantage of advanced technology. SSA's assumption was that with relatively simple reconfigurations of existing computer systems and some purchases of new equipment in the first phase of its modernization, a large amount of labor-intensive operations could be eliminated and performance immediately improved.

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[1] U.S. Department of Health and Human Services, Social Security Administration, Office of Systems, *Systems Modernization Plan: From Survival to State of the Art*, Publication No. 41-002, 1982, p. 1-19. Hereafter cited as SMP 1982.

Upgrading technology in such a way as to be compatible with SSA's old computer codes would be difficult, since the agency had to avoid both demanding an architecture and software that was compatible with only one kind of equipment (IBM), as required by the Brooks Act; and massive reconversions of software.

SMP began in 1982, although it incorporated some improvement projects that were already underway. In the discussion below, some rough indications are provided about the allocation of resources among and between SMP program areas, to indicate something about the relative importance of tasks and objectives. However, this gives only a very poor indication of the distribution of effort and resources; some objectives have been shifted from one program to another between 1982 and 1986. Even the overall SMP expenditures indicated by SMP publications are only approximate, since some projects have been included under SMP in 1 or 2 years and not included in other years, for reasons that are not clear. This is one problem that complicates any external evaluation of progress in implementing the SMP.

Combined with strong governmentwide emphasis on budget-trimming and work force reduction, the announcement of the systems modernization effort in 1982 caused SSA employees considerable anxiety. As in any organization acquiring new technology, many workers were concerned about their ability to learn to use it. At the same time, most employees were eager to have technology that could help them overcome the constantly increasing backlogs and recurring crises, and the union was not opposed to more automation. SSA however failed to keep its employees well informed. In early documents there was no mention of the touchy subject of effects on the level of employment. In a brochure published sometime in 1984,[4] SSA states that "an overriding consideration" was that "all current SSA employees must be assured of job security," but the promise is not part of the formal documentation of SMP. Only in 1985 did SSA announce an "aggressive" plan to inform employees about SMP, and in January 1986 it distributed to field operations employees a simplified "Field Edition" of the plan. Questions about job security were still not addressed directly.

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[4] U.S. Department of Health and Human Services, Social Security Administration, *Systems Modernization Program—An Overview*, no date.

SMP PROJECTS AND PROGRAMS

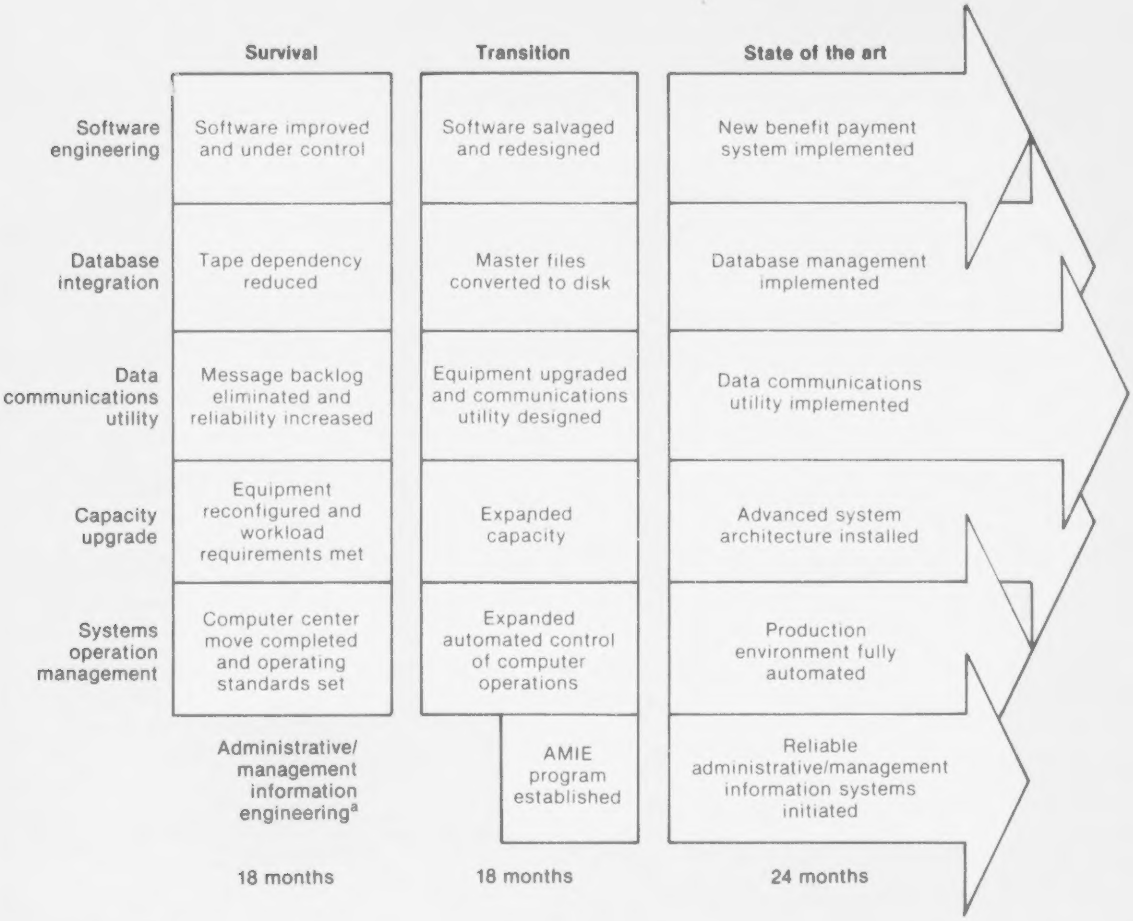
The 1982 SMP called for four program areas: software engineering, database integration, data communications utility, and capacity upgrade. The three chronological phases of the program were labeled survival, transition, and state of the art (see figure 2). The survival phase consisted of actions to survive the immediate crisis, which is described in chapter 6. The transition phase would bring SSA up to a "contemporary data processing capability." These phases were each to take 18 months, and to be completed by 1985. The state of the art phase, the final 2 years, would develop the new software, new databases, new communications utility, distributed processing, and the final hardware configuration to achieve final integration, and the testing and certifying of the redesigned system. By 1988, with this achieved, SMP would evolve into a continuing 5-year planning and enhancement cycle.

One important objective of the SMP is modernization of the claims process, which is perhaps the primary point of interface between SSA and its individual clients.

The Claims Modernization Project (CMP)

This project is in effect a plan, or a depiction of the major desired outcomes of the SMP, and it is therefore described first. CMP is

Figure 2.—An Overview of the Social Security Administration's Systems Modernization Plan



	Survival	Transition	State of the art
Software engineering	Software improved and under control	Software salvaged and redesigned	New benefit payment system implemented
Database integration	Tape dependency reduced	Master files converted to disk	Database management implemented
Data communications utility	Message backlog eliminated and reliability increased	Equipment upgraded and communications utility designed	Data communications utility implemented
Capacity upgrade	Equipment reconfigured and workload requirements met	Expanded capacity	Advanced system architecture installed
Systems operation management	Computer center move completed and operating standards set	Expanded automated control of computer operations	Production environment fully automated
Administrative/management information engineering[a]		AMIE program established	Reliable administrative/management information systems initiated
	18 months	18 months	24 months

[a]Not included in original SMP

SOURCE: U.S. Department of Health and Human Services, Social Security Administration, *SSA Systems Modernization Plan: 1985 Update*, Publication No. 40-004, January 1985.

SSA's closest claim to a vision of how it wants to do business, SSA's version of "the office of the future." Since SMP is a 5-year plan, this is, however, a near-term future.

At headquarters, the four major programs (old-age insurance, survivors insurance, disability insurance, and supplementary security income) are fragmented and spread over 10 functional offices under four deputy commissioners (see figure 3). They come together in the district offices, where SSA meets its clients. These district offices are now largely paper-based operations, with cases represented by file folders. Clients must wait for service representatives to send messages to headquarters and receive information back about the client's records by way of the one or two SSA Data and Retrieval System (SSADARS) terminals, manned by a data technician, in the back office. CMP will make the field offices into modern, automated offices in which representatives use on-line, interactive systems for both the initial claims interview and later for case control. There are prototypes in two field offices,[5] where research is being conducted on

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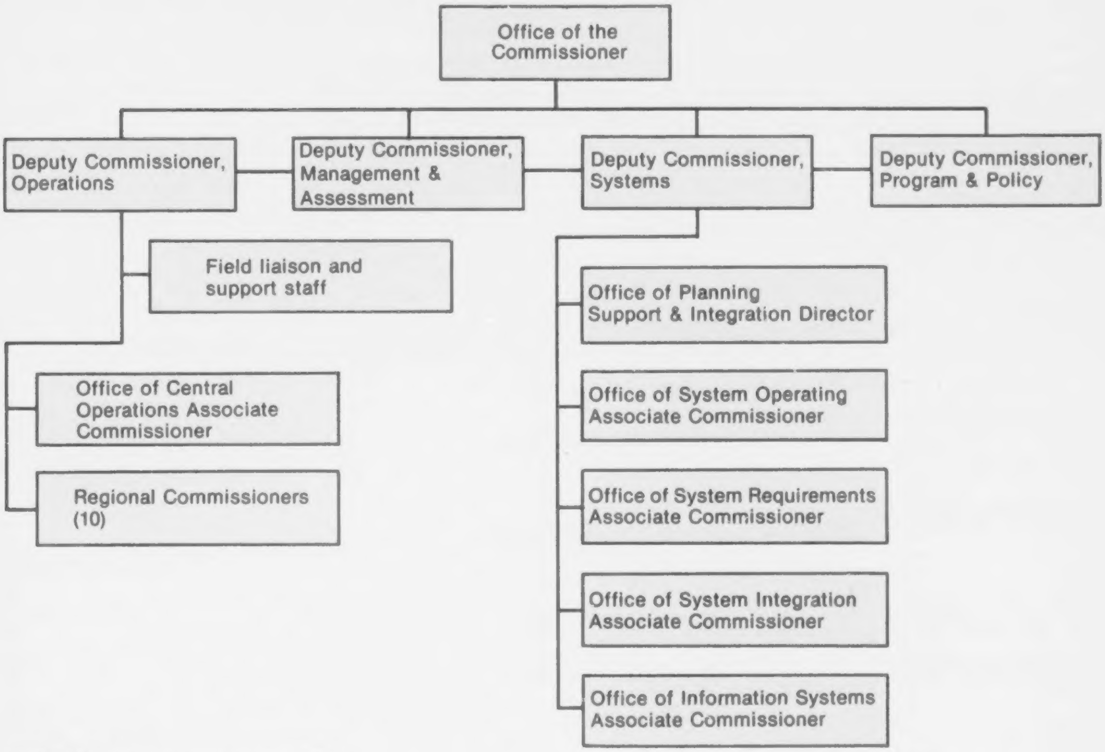
[5] York, PA, and Baltimore, MD.

Figure 3.—Organizational Chart of Social Security Administration as of Apr. 4, 1986 Focusing on Systems Implementation


Office of the Commissioner
Deputy Commissioner, Operations
Deputy Commissioner, Management & Assessment
Deputy Commissioner, Systems
Deputy Commissioner, Program & Policy
Field liaison and support staff
Office of Central Operations Associate Commissioner
Regional Commissioners (10)
Office of Planning Support & Integration Director
Office of System Operating Associate Commissioner
Office of System Requirements Associate Commissioner
Office of System Integration Associate Commissioner
Office of Information Systems Associate Commissioner

SOURCE: Social Security Administration, 1986.

its impact on the labor force. By 1988 SSA expects the system to be in place nationwide.

A claims representative will interview the client, asking questions prompted by a desktop computer screen. The results will be transmitted directly to Baltimore and will go through a communications processor located in one of the six program service centers where the claim is further processed for earnings information. The results of the interview will also be printed out locally for the client and for use in case control.

This will eliminate the need for the claims representative to queue up for the one or two office SSADARS terminals as she or he now does. It will also eliminate most of the Data Review Technicians, the people who now key data into SSADARS. (Some will be retrained as service representatives.)

This office of the future is still an objective, not an accomplishment, but by January 1987, the first phase of implementation will begin. There is a prototype model office at headquarters, and there are pilot sites in SSA regions. Two pilot sites are already working with borrowed GSA terminals, of the kind the U.S. Senate is now retiring from Senators' offices. In large service organizations of the the private sector, CMP would not be regarded as an "office of the future"; at best it would seem moderately up to date.

Eventually, SSA's batch-processing based claims system will be fully redesigned and automated, as will postentitlement control and audit functions. The first phase of the project, however, deals with initiating claims. In the first 2 years, at least, the interactive terminals will be used chiefly for tasks related to initial claims filing. Software for postentitlement procedures will not be ready; the postentitlement process has yet to be redesigned. SSA's plan is to procure all of the interactive terminals at once (in 1987) so that CMP provides a model for and a basis of automating other operations. An alternative would be to procure terminals now only for some pilot sites, with automation and modernization of all 13,000 field offices to be phased in after 1990, or when software development is complete. The advantages of automating at least a portion of the work immediately, providing improved service in all rather than a few communities, giving employees experience in using the equipment, (and for SSA, locking in the allocation of no-year funding) must be weighed against the costs for temporarily underused capacity, and the uncertainty of relying on software that is not yet developed. SSA insists that immediate procurement is necessary for smooth progress in SMP implementation.

In August 1986, GAO recommended that SSA not proceed with the full procurement until there is a full evaluation of the complete system, although GAO did not clearly specify how this was to be accomplished.[6] GAO's recommendation was based on the grounds that the agency has extricated itself from the 1982 crisis and "these procurements are not supported by documented deficiencies in current ADP operations." GAO also said that there were deficiencies in specifying functional requirements for system components, and in SSA's cost-benefit analysis for the procurement. The GAO report did not, however, place this recommendation in the context of SMP as a whole, or SSA's related management problems.

The decision about the procurement should, however, be made in the context of SMP as a whole. To argue that because the 1982 crisis was surmounted (i.e., Phase I of SMP succeeded), the second phase of SMP is not necessary, amounts to rejecting the goal of systems modernization that both the Administration and Congress accepted in 1982. The analysis of the costs and benefits of this procurement (or rather, the timing of this procurement) should include the effects of its timing on other aspects of SMP implementation. The risk of proceeding with the procurement is basically the risk of incurring the cost of unused telecommunications and computer capacity while software is developed for automating additional field office services. Delaying the procurement indefinitely may involve other costs, including foregoing possible productivity gains in claims processing, plus the risk that reductions in staff may cause a deterioration in services to claimants. The August GAO reort did not address these broader considerations. Strong corrective actions by SSA, DHHS, OMB, and Congress may be necessary to resolve persistent SMP implementation problems, but they should not be driven by this procurement in isolation from the broader and more important issues. The option of a cautious go-ahead for the procurement, with intensified monitoring and oversight, should be considered.

The Software Engineering Program (SEP)

Software engineering is a new discipline that aims to improve software through providing better tools, concepts, and methods for software development and testing, and insisting on their consistent and systematic use. SSA's software engineering program however was designed to retain (so far as possible) and upgrade existing software so that an entirely new code would not be necessary. It would also develop requirements for new software and new applications, and reconfigure the database architecture so as to take advantage of new technology. Finally, it would develop standards and productivity tools for software development. Special emphasis was to be put on modern program documentation, standardization of programs, and conversion to high-level languages where possible.

SSA developed a software engineering technology manual between 1983 and 1985, but it was found to be incomplete and lacking in necessary provisions for quality assurance and compliance, according to GAO; work in this area is continuing.

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[6] U.S. Congress, General Accounting Office, *ADP Acquisitions: SSA Should Limit ADP Procurements Until Further Testing is Performed*, report to the Chairman, Committee on Government Operations, U.S. House of Representatives, IMTEC-86-31, August 1986.

There were in 1982 some 12 million lines of poorly written and undocumented program code. There were about 6,000 COBOL* programs, 1,500 assembly language code programs, and another 1,000 miscellaneous programs. Over the years SSA had translated old manual procedures into software using now outdated programming languages, and then, converted them line by line to COBOL, preserving the inefficiencies of the older technology. The old code is being cleaned up and rewritten as it is needed, according to SSA.

The software engineering program has fallen far behind schedule. However, SSA claims to have accomplished the systematic definition of its information requirements, for the first time in SSA history. This was done using topdown Business Systems Planning, a technique for analyzing an organization's "business functions" and defining the needs for software applications. A second technique, Critical Success Factors Identification, was also used. Establishing the information requirements was a critical first step to help the agency conceptualize the uses of data in its procedures, and to lay out a general plan for a systems architecture (the hardware and software that would be used to modernize and automate these procedures). Thirty-five SSA analysts then interviewed over 200 managers and workers throughout SSA to get a detailed picture of the agency's business and information requirements and an evaluation of existing software, which was inventoried for the first time. More than 180 systems-related problems and needs were identified. This work is continuing, with groups of users from the field office periodically brought into headquarters to work with the Strategic Planning and Integration staff.

There is, nevertheless, considerable doubt among many SSA systems developers and expert observers as to the adequacy or quality of the functional requirements, as defined, in some areas; some are still not developed at a level of detail that can effectively guide systems redesign and development. Internal reviews of specific functional requirements repeatedly speak of incomplete functional decomposition, improperly partitioned and poorly named data categories, ambiguities and contradictions between data flow diagrams, and many other technical flaws.

A baseline Software Engineering Technology manual has been prepared. An interim Debt Management System and a pilot of a Modernized Claim System are in operation. A software improvement process has begun. Over the next 5 years the program will design and develop Logical Application Groups, described as methods and systems for enhancing security controls and auditing capability.

The redesign of the batch-oriented claims system to a contemporary interactive system aims at allowing immediate eligibility and entitlement determinations, automated computations of benefits, and enhanced control and audit functions. SSA has established in its central office a model district office and a test processing module to evaluate software for district offices. Data-entry screens have been designed for district offices and the processing center. A project is underway to obtain at least 22,000 interactive terminals for district offices (the claims modernization project, as described above.) Field offices are now pilot testing some interactive systems. These projects will be further discussed below.

The annual wage reporting system was also to be redesigned, and employers were to be encouraged to report wages on magnetic media rather than paper. However, this project became unnecessary when new Internal Revenue Service regulations required that all organizations with more than 500 employees file reports on magnetic media by 1986, and those with over 250 employees do so by 1987.

In 1981, SSA had $2 billion in outstanding debts owed by people who received over-payments. A new Interim Billing and Follow-up System was put in place in 1984 as a first step in improved debt management. This is supposed to be replaced by the new Debt Management System by the end of 1986, which should further reduce the average age of receivables and maintain better accountability over all debt collections. The new system will provide on-line access to information about overpayments, bills and notices that have been sent, and resolution agreements. It may not be usable in all program areas by the end of 1986, however. There are problems in completing the design for, and implementing, the new National Debt Management System, because it must interface with postentitlement systems and procedures which are still to be redesigned and automated; thus the functional requirements for the debt management system are incomplete.

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*Common Business-Oriented Language.

The automated enumerations screening process, begun in November 1984, gives SSA the capability to process requests for social security numbers in 1 day; currently only 3 percent of requests require any clerical intervention.

The 1982 SMP called for existing software to be "made maintainable and transferable" and to be fully documented by 1985. This has not been accomplished. All future development of software is to use software engineering technology—e.g., strict rules, procedures, and criteria to make sure that it can be fully understood, added to, improved, and corrected when needed. The software engineering technology was supposed to be ready for full "institutionalization" by 1986. It is not complete, and what has been introduced is not always strictly enforced. However, SSA is installing modern techniques to measure compliance, which should then improve.

The software engineering program was estimated in the 1982 program to cost $103 million, or 21 percent of the total SMP 5-year cost. In the first 3 years, 28 percent of SMP expenditures went to this program. Its total cost according to the 1986 SMP will be about $200 million through 1990, still about 21 percent of the projected total.

On August 30, 1985, GAO released a report to the Senate Committee on Appropriations concerned with SSA's ability to meet congressional needs expressed in new legislation.[7] GAO cited delays in the SMP database management program, and software efforts. It said that SSA had failed to document existing code (over 10 million lines) as originally promised in the SMP and instead had chosen to ignore this problem while developing entirely new systems in the absence of software standards and enforcement. While praising SSA for its hardware acquisition program, GAO concluded that SSA had made little progress "in improving its ability to respond to legislative changes that require software modifications to existing systems."

Within the executive branch, SMP's software program has also come under criticism. In the Department of Health and Human Services (DHHS), the Assistant Inspector General for Audit, Felix J. Majka, conducted a review of the claims modernization project from late 1983 through May 1984, and found numerous deficiencies. The HHS Inspector General, Richard Kusserow, issued reports in February 1985 and again in June 1985, criticizing SSA for wasting over $1 million in the procurement of useless software. Kusserow criticized SSA for "poor planning and management of a software replacement effort." He pointed to the Claims Automated Processing System upgrade, saying that software purchased from a vendor was unusable. A similar result occurred with an upgrade of the Manual Adjustment Credit and Award Process (MADCAP), and the conversion of earnings program software.

Critics inside and outside SSA point to the software program as most behind schedule and suffering from poor management. In interviews conducted by OTA, critics said:

> Senior management has seriously underestimated the difficulty of examining, documenting, and rewriting 10 million lines of code found in SSA's major problems.
>
> Standards developed to control software development are not being enforced.

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[7] U.S. Congress, General Accounting Office, *Social Security Administration's Progress in Modernizing Its Computer Operations*, IMTEC 85-15, Aug. 30, 1985.

> The functional (detailed) requirements of SSA's major systems have not been produced on schedule. We are about 18 months behind here.
>
> The Business Systems Plan was a nice exercise, but it did not lead to redesigning major SSA processes.

These criticisms, and those of GAO and the Inspector General in 1985, may be too severe in 1986, since SSA says much progress has been made in the past year. This claim, however, is difficult to document and relies on SSA assertions. SSA has discovered, as have many business organizations, that software engineering is not a scientific formula but a set of tools for better programming. Installing these tools does not guarantee that they will be used or that good code will in fact be produced. Some private sector studies indicate that even intense application of the tools brings only modest gains in productivity; other experts argue that it can double productivity. Getting SSA programmers with 20 years' experience to use new tools is indeed a major problem in itself, but SSA is now improving its monitoring of how much of the new code is produced in accordance with software engineering standards.

The promise, implied or explicit, to document 10 million lines of old code was probably misguided in the first place, and the "failure" to pursue this objective rigorously is probably wise. New operational procedures related to the claims modernization process will avoid the need for cleaning up some of the old code, and the rest can be done as needed.

SSA has made considerable progress in improving its software, but just as clearly this is the area in which SMP is most behind, and may be seriously floundering. A critical problem seems to be the need for more expert personnel in this area.

The Database Integration (DBI) Program

The DBI program has achieved its first and second phase objectives, essentially on schedule. One objective was to improve the management of over 1 trillion bytes of data per year, a volume which increases by billions of bytes each year. In 1982, SSA had limited access to its most important systems and production files, which were on magnetic tape. Use of over 500,000 reels of tape required extensive scheduling and a large clerical staff just to file and move the tapes. Over 30,000 production operations each month required 150,000 tapes to be handled several times, causing human errors that were estimated to consume each month about a quarter of available computer hours.

It was very difficult to determine the number of data elements maintained on the various databases. There was no single formal data dictionary with standard definitions of all the data elements.

One purpose of the DBI program was to reduce the use of magnetic tape through the use of shared Direct Access Storage Devices and to establish a data administration function (i.e., a data dictionary) for logical definition of data elements and files. This would make it possible to use available hardware and software technology to create a modern integrated database.

In its first phase, the DBI program placed the Master Beneficiary Record and Supplemental Security Record master data files onto disk storage, and provided on-line access to this data for field offices, through the one or two Paradyne data communications terminals that each office already had. SSA says that this project is on schedule. The number of tapes in active use has been reduced from 500,000 to 250,000. More than 360 disk drive units have been installed.

A file management and file access system—the Master Data Access Method, or MADAM—was developed to handle more than 500,000 queries a day. Data has been separated from applications programs, so that it can be used and updated independently; this is essential for modern data management. For the user, MADAM appears to be a modern database management system; the user asks for data, and gets it, without knowing how to use various separate software programs. In fact, however, MADAM extracts the data from a variety of separate files rather than from one integrated database. The other new software program that performs in this way is the critical payment system. The ability to update all files at once, automatically, must await a more modern database management system.

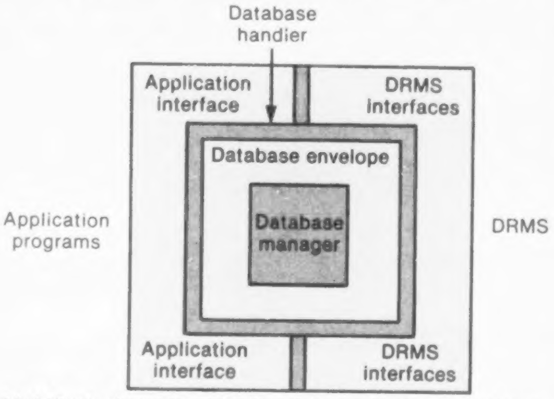
The earnings systems, enumeration systems, and postentitlement claims systems update the major master files, now on disks, using batched sequential access. SSA is still working toward modern data administration, with a completely integrated database.

SSA's recently developed data dictionary describes over 50,000 data elements. A data dictionary, one of the first steps in data administration, defines the data elements—that is, the pieces of information—that should go into a database and dictates the form they will be uniformly given and their labels, or the terms used to call them up, so that retrieval and processing is easier. Although the new data dictionary is widely cited by SSA as a major accomplishment, it is valuable only if it is rigorously used. This may not be the case; OTA was told by some people at SSA that the dictionary was often not adhered to in writing programs and "new uses and new data definitions are popping up all over the place."

The data dictionary, even if rigorously used, does not solve SSA's problem. The agency already has about 80 million records on RSI rolls and 10 million on SSI rolls, accumulated over 50 years, with data categories defined in many different ways over the years. The attempt to purify or clean up SSA's data is staggering; one master file run through a data cleaning program reportedly "produced 3 billion lines of print and 120 million *invalid* values."

The DBI program has defined a "target database architecture"—that is, the general kinds of structure, software and hardware, that are needed for organizing its databases, but it has not yet worked out what that architecture will be (see figure 4). When the new database architecture is decided on and implemented, it should have tools to assure that all databases can be updated in synchrony; that has not yet been accomplished.

Figure 4.—The SSA Characterization of the Database Architecture To Be Used in SMP



SOURCE U.S. Department of Health and Human Services, Social Security Administration, *SSA Systems Modernization Plan: 1986 Long-Range Strategic Plan*, Publication No. 40-004, October 1985.

GAO contended, in a report to the Senate Appropriations Committee in August 1985, that SMP is behind schedule in developing an integrated database because of delays in procurement.[8] In late 1984, a $9.8 million request for proposals for database architecture development was issued, but only six vendors bid, and those were judged technically incompetent. The procurement was withdrawn and canceled in May 1985. The major vendors did not bid, reportedly, because the venture was too risky and SSA allowed only 4 weeks to write a proposal. Some potential vendors said that SSA asked for an "overly ambitious architecture,"[9] and complained that the Request for Proposals was vague and confusing. SSA throughout 1985 said that it had moved ahead with developing an architecture on its own, and had made up the time lost on the failed procurement.

Yet in 1986 SSA was still struggling to develop a database architecture. In April 1986 SSA told OTA that it had "re-examined" a database management system produced by Cullinet, IDMS/R (Integrated Database Management System/Revised), which is already in use in HHS, and decided that it would adapt the SSA database architecture to use this software package, which according to SSA is compatible with its existing software, including MADAM. Whether or not this could solve SSA's architecture dilemma is far from certain. IDMS/R is not one of the newest database management systems available, but it is widely regarded as a good system, and it has replaced IBM's database management system in many large corporations. But some information indicates that SSA is not, in fact, structuring an architecture that can use IDMS/R but merely "layering" IDMS/R over MADAM—that is, using information retrieval and data management systems to obscure the fact that it still has no firm plan for database integration. These changing and conflicting reports provide an excellent example of the near impossibility, for those not inside an agency with hands-on access to its systems, of distinguishing what is being done in implementing information technology plans from what an agency reports it is doing.

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[8] U.S. Congress, General Accounting Office, IMTEC 85-15, op. cit.

[9] U.S. Congress, General Accounting Office, *Social Security Administration's Computer Systems Modernization Effort May Not Achieve Planned Objectives*, IMTEC-85-16, Sept. 30, 1985.

Failure to settle on a database architecture in the near future could have severe consequences in terms of lost productivity. Fourth generation languages operating in a modern database could save thousands of hours of programmer time. Many applications could be written in more efficient advanced languages. However, existing programs, those already written, will be compatible with the proposed database architecture. It is in the area of lost productivity that SSA would pay a price for failure to develop a database architecture.

The most controversial accomplishment of the data integration effort is perhaps the Master Data Access Method, or MADAM, the file management system that SSA developed when it converted from tape to disk storage. Many experts thought that SSA should have sought or adopted off-the-shelf software for this purpose, which would be maintained by vendors, rather than developing its own, which it must maintain (that is, improve, modify, and update). MADAM may well be incompatible with future mainframe operating systems, database management systems, and fourth generation languages. Thus SSA incurs future risks of incompatibility and long-term maintenance costs. In the short term, there are also risks and costs. MADAM is apparently a very complicated and poorly documented system, so that only a small group of people are sufficiently knowledgeable to operate it, yet it is the basis of SSA's data management. This constitutes a peculiar vulnerability to smooth operations if there is any short-term emergency, sudden work force reduction, or drastic reorganization.[10]

The DBI program was allocated about 14 percent of projected SMP costs in 1982, or $65 million. But according to the 1986 Plan, its total cost will be less than $30 million (3 percent of SMP) although SMP costs as a whole have doubled. This revision occurred after the failed request for proposals for a contractor to develop a database architecture, when SSA decided it would be done in-house; presumably it represents the estimated difference between in-house and contractor efforts. When the 1985 SMP Update was published, 3½ years into the plan, this program had expended about $7.8 million, or 4 percent of total expenditures.

The Data Communications Utility (DCU) Program

The DCU program is to reengineer the three major telecommunication networks to constitute a data communications utility; that is, a conduit for transmission of data between and among processing points. With the existing SSADAR system, there are only one or two communications terminals in each office, operated by a data technician, and service representatives have long waits for sending and receiving messages. In its first 7 years, the SSADAR system failed frequently, and was sometimes inoperable for long periods. During the first half of 1981, it was "down" about 11 percent of the time, or about 1 hour of each working day, on the average. The most immediate objective was to increase the reliability of communications ("the mean time to failure") by 20 to 30 percent, and to reduce the amount of "downtime."

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[10] As one internal critic said, "If these people get sick, die, leave, or just get mad, then all of SSA's on-line operations could go down." Another official charged that "the people who built MADAM . . . refuse to give management the schematic diagrams and documentation on how MADAM works. All they give us is the commands and a users manual." Several SSA officials concurred in the conclusion that a few people have used their exclusive knowledge of MADAM to resist efforts to develop a database architecture without MADAM, and that MADAM will have to "be built around" in designing the architecture. In short, MADAM has become a focus of internal tension and dispute as well as external criticism.

Communications software improvement began within the first year of SMP. The objectives were: 1) to eliminate the daily return message backlogs; 2) to achieve an acceptable response time, even if the 1982 volume of daily transactions doubled; and 3) to be able to serve the needs of all SSA users (including those using the new interactive terminals).

The two host computers (IBM 370/168s) were replaced in 1983, trunk lines were added, and telecommunication monitors upgraded. These immediate improvements significantly reduced or eliminated long communications backlogs.

The 1982 plan was that by the end of 1985, communications software would be improved to make it "maintainable and transferable," replacement concentrators[11] and processors would be installed, the concentrators' software would be converted, local intelligence would be installed at district offices, and specifications would be completed for the final data communications utility (i.e., communications lines, etc.).

The general design of the communications utility has been completed, and in 1987, three very high-capacity machines will increase teleprocessing capacity by seven times over. This will be essential as the on-line claims modernization project, already described, comes to fruition.

The DCU program is essentially on time. It is expected that contracts for procurement of the 22,000 to 39,000[12] interactive terminals will be let by late summer of 1986, and that installation will begin in the fall of 1986.[13] But critics have raised serious questions about whether this program should proceed as planned. There are in fact two separate controversies surrounding the program: whether the basic strategy is sound, and whether SSA's pacing of its implementation is reasonable. In regard to the basic strategy, two questions are often raised:

1. Should SSA be planning to decentralize its processing rather than to rely on interactive communication between field offices and processing computers at headquarters?
2. Can SSA be sure that the traffic between district offices and field offices can be handled?

The 1982 SMP strategy is basically one of creating a highly centralized system. This runs counter to a strong trend for large organizations to decentralize their operations as much as practical, in both the private sector and the public sector; for example, the State of Utah began to move toward distributed processing for government operations in 1979, well before the SMP was formulated.

Distributed data processing was in fact a part of the SMP strategy as first announced in 1982. How the SMP strategy came to be one of complete centralization of processing is somewhat mysterious. The 1982 SMP included "install[ing] local intelligence at all District Office terminals." This was a response to GAO criticism in 1979 of SSA's planned procurement of Paradyne (dumb) terminals, which predated the SMP. In order to satisfy GAO's criticism and still proceed with that procurement, SSA agreed, in 1980, that the Paradyne terminals would be enhanced in memory capacity at some time after they were installed, to allow distributed processing. Because of persistent problems with the Paradyne terminals the vague plan to upgrade the terminals was dropped. (This situation is described in ch. 7.)

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[11] Concentrators are the minicomputers which receive data and query messages from field office terminals, through modems; and then condense, edit, and reformat the messages and send them on to two main host computers. The concentrators also send response messages to the proper field office terminal.

[12] The procurement is to be for 22,000 terminals with an option for an additional 17,000; with peripherals, etc., about 60,000 devices will be procured.

[13] The schedule calls for award of a contract in August 1986 (competition closed in January 1986), installation of a test site in the National Computer Center in September, and beginning of installation at 20 pilot sites (claims field offices) in October. All terminals must operate without fault for at least 30 full days out of 90. On acceptance, 500 will be installed the first month, 1,000 the second month, and 1,500 each month thereafter.

After 1982, mention of distributed processing was quietly dropped out of SMP descriptions. Strangely, this decision—or nondecision—seems almost to have gone unnoticed. At late as January 1985, the HHS Inspector General, in a memorandum to Acting SSA Commissioner McSteen, said:

> We also found [in a review ending May 1984] that SSA had decided to centralize computer processing even though the original SMP called for local processing (decentralized). Documentation to support this decision, however, was not available . . . SSA said that the basis for deciding to process centrally was documented, however, we have not been able to obtain this documentation.[14]

SSA officials now say somewhat vaguely that they are studying the distributed processing option and will "move in this direction" in future planning. They claim, however, that to add "local intelligence" would cost approximately $25,000 per field office, or about $40 million, and that both technically and economically their strategy is the more defensible choice. The agency has, to this point, held to a belief that centralized control is necessary to protect the integrity and security of its data. SSA systems planners argue also that distributed data processing would force them to choose between:

1. maintaining seven or more compete databases in regional centers, with the difficulty of assuring that they are simultaneously updated and rigorously consistent; or
2. dividing the beneficiary files between regions, with the difficulty that beneficiaries are highly mobile and may turn up at unexpected locations for service.

Neither of these are insurmountable difficulties, given modern data-processing and telecommunication capabilities. However, this does not necessarily mean that SSA's choice of centralized data processing is wrong or unreasonable. It is true that there are limits to the efficiency of enormously large databases dependent on a few central computers. Centralization increases the vulnerability of nationwide operations to a breakdown at the hub, while decentralization would provide some redundancy and limit the effects of regional interruptions or failures. On the other hand, centralization allows for more management controls, better security, and greater redundancy, or better backup systems. Most large financial corporations, in fact, are not decentralizing their data-processing operations. This is one of the many points on which experts disagree, and SSA's decision does not fly in the face of accepted professional practice.

For the present, field offices will by means of communicating terminals be given the same functions, capabilities, and access that they would have with distributed logic, according to SSA. The communications network will be be capable of accommodating processing at any of the communications node, and so will not be a hindrance to any future decentralization of processing capability.

As to the manageability of traffic under SSA's plan, some critics point out that the SSADAR system was designed in 1974 to handle 20,000 messages and 80,000 data transactions per day, and that within 1 year the host computer capacity was saturated, while since then the transaction loads have increased over 500 percent. They argue that the system could again become overloaded as the traffic from up to 39,000 terminals is phased in. Just as highway improvement often encourages additional traffic and ultimately results in more, rather than less, congestion, the use of the communications network could exceed expectations.

SSA is confident that it has adequately projected and modeled traffic on the system for the foreseeable future. Basically, it has determined the maximum number of transactions

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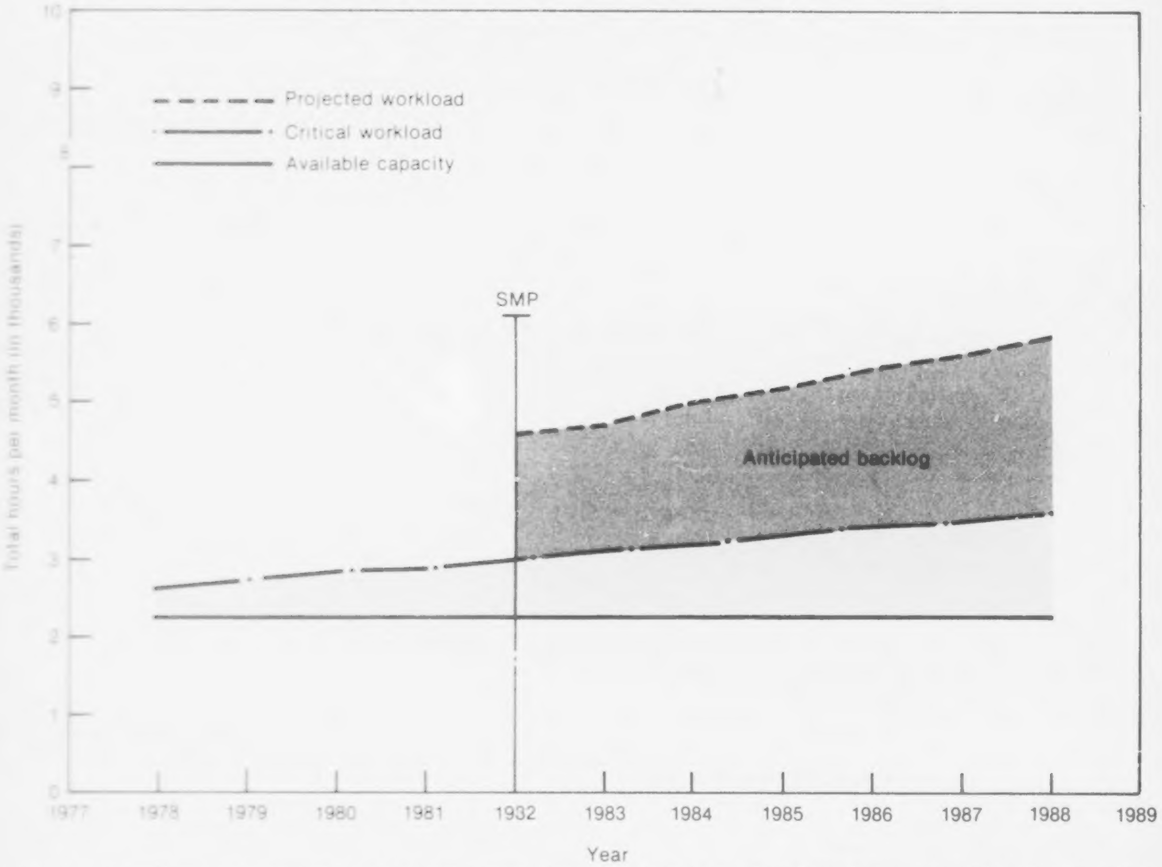
[14] U.S. Department of Health and Human Services, Office of Inspector General, Memorandum to Martha A. McSteen, Acting Commissioner of Social Security, ACN 15-52654: Audit Report—SSA's Redesign of the Claims Processing System Under the Systems Modernization Plan (SMP), Jan. 30, 1985.

Figure 5.—Available Computer Capacity and Projected Workload Requirements of SSA's Computer System, as Projected in 1982



SOURCE: U.S. Department of Health and Human Services, Social Security Administration, *Systems Modernization Plan: From Survival to State of the Art*, Publication No. 41-004, February 1982.

that a service representative can complete per hour, and planned a system that would accommodate all field office personnel making maximum use of the system at the same time (which assumes that the number of field offices and service personnel will not be increased).

The second controversy about the program has already been discussed above, under the claims modernization project; it concerns the timing of the procurement of the interactive terminals.

The DCU program was originally estimated at $160.5 million or one-third of total SMP costs. By September 1985, it had expended $12.9 million, or 7 percent of SMP expenditures. Big investments are scheduled for fiscal years 1987 and 1988 ($184 million). By 1990, this program is projected to cost $273 million, about 28 percent of total SMP costs.

The Capacity Upgrade (CU) Program

The CU program directly addressed the crisis under which SSA in 1982 could no longer meet the elementary, basic demands of its programs for computing. Figure 5 illustrates the historic growth and projected workload of SSA computers. In 1982 SSA estimated that it needed 5,000 CPU (central processing unit) hours per month to handle its workload plus its backlog, and that its installed capacity provided only 3,000 CPU hours, which was effectively reduced to 2,000 by "insufficiency of operations staff." The CU program was to reconfigure and consolidate the computing sites distributed around SSA headquarters, to acquire much higher capacity and more modern computers, eliminate magnetic tape files and switch over to direct access devices, develop a local computing network for high-speed data transfers, and enhance the peripheral equipment (such as printers).

The programmatic systems computers have been upgraded and a separate test and development facility was purchased. Computers that averaged only 270 hours "mean-time to failure" (MTF) were replaced with machines that average 19,000 hours MTF. National Advanced Systems telecommunication processors have been installed, as have smaller systems for decision support, development, and management of the larger systems. Additional hardware upgrades are planned in 1987, at which time capacity will be far in excess of workloads anticipated in the SMP.

By 1986 computers at the National Computer Center, used for programmatic, administrative, and test work, had all been replaced and modern disk storage had been largely achieved, although SSA still has an enormous library of tapes in active use. Operating systems software has been modernized, laser printers installed, and several terminals added for software program testing.

The computers in the six Program Service Centers still must be replaced. Four of these are IBM 360/65s that are obsolete by any reasonable criteria. They have smaller capacity than many personal computers, but are still running major program activities, although constantly threatening a breakdown.[15] The 1982 plan called for this replacement to be accomplished by the end of 1985, but a procurement contract award was protested under the Competition in Contracting Activities law,[16] which has delayed the replacement. In general, however, hardware acquisition and capacity upgrading is on schedule.

New hardware and system software must also be acquired for the National Debt Management System, and the Logical Applications Groups. The Test and Time-Sharing Facility must also be upgraded.

The CU program was planned in 1982 to account for 28 percent of SMP, $132.5 million. By September 1985 it had spent $72.7 million, or 41 percent of all expenditures to that time. Other large procurements are planned for 1987. By 1990, $237.8 million will have gone into capacity upgrade, or 24 percent of the expanded SMP budget.

The System Operation and Management Program (SOMP)

The SOMP was not in the original SMP, but was added to develop automated tools and procedures for managing computer operations. It has implemented automated job scheduling at the National Computer Center, as well as computer monitoring, training, and an integrated control facility. The small program is projected to cost $27.6 million by 1990, or less than 3 percent of total SMP costs, is on schedule.

The Administrative/Management Information Engineering (AMIE) Program

AMIE was added to SMP in 1984. The SMP originally focused on data-processing needs to carry out primary program responsibilities, and gave little attention to managing SSA's resources or providing executives and managers with information needed for decisionmaking and policy. Recognizing that SSA badly needed a management information system,

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[15] The Deputy Commissioner for Systems says wryly that "only SSA and a few Third World Countries still use these computers."

[16] A potential supplier protested because the specifications did not make allowance for reconditioned equipment. SSA was faced with accepting the possibility of using reconditioned equipment which meets its specifications but would put SSA several years behind state-of-the-art technology, or rewriting the specifications to require some newly developed features, which would not only further limit competition but would significantly delay the acquisition. It chose to revise the request for proposals to allow vendors to offer reconditioned equipment.

Acting Commissioner Martha McStean in April 1984, added this program to develop management information systems software, automate and modernize administrative practices, and encourage end-user development of new applications.

An agencywide survey was completed to determine management information needs. An information center was developed to spur microcomputer applications; microcomputers have been piloted in 20 field offices to study their uses. A Financial/Administrative Integrated Management System was installed using fourth generation database language (IDMS/R). This led to the belated recognition that it may be possible to use IDMS/R for SSA's overall database management, as already discussed.

The AMIE was allocated $311.4 million or over 37 percent of SMP in the 1985 Update of SMP; the 1986 version scaled this back to $197 million or 20 percent. The cost might have been considerably less if management information needs had been integrated into the original plans.

PLANNING AND INTEGRATION

SMP is a rolling 5-year plan, meant to be updated each year. Both the planning and the effort to integrate SMP across programs is the task of the Office of Strategic Planning and Integration, within the Office of Systems. This OSPI has a staff of 100. There are weekly meetings between representatives of the SMP programs described above, with the integration contractor. In addition, efforts are being made to involve operations people in systems planning, since they are the ultimate users of the systems. Some critics, in fact, argue that operations considerations are determining the directions for SMP, and that this guarantees that the emphasis will be on rocking the boat to the least extent possible; that is, minimum change in SSA procedures and customs rather than deriving maximum benefit from advanced technologies. This may, however, be a rational choice for SSA at present.

Other critics, including people within SSA, maintain that little or no integration is occurring, and that the integration contractor is often diverted to other tasks. It should be noted, however, that "integration" is a loose and relative term, and can only be demonstrated by long-term results of SMP implementation.

The integration role contract will be recompeted when it expires in the fall of 1986 and provision has been made for a 3-month overlap with the old contract, so that there will not be a lapse in this function should a new contractor be selected.

EVALUATING THE PROGRESS OF SMP

It is difficult to measure precisely the progress of a very large organization in a near billion-dollar effort over 8 years (1982 to 1990), an effort with multiple goals, strategies, and areas of effort. One measure is increased productivity, or to be more accurate, achievement of work force reduction goals. Other indicators of progress are more qualitative or judgmental. This study relies on inspection or analysis of several hundred documents, supplemented with more than 50 interviews with current and former SSA employees at all levels, with congressional committee staff people; with officials at the General Accounting Office, the General Services Administration, and the Office of Management and Budget; with computer vendors and contractors; and with other well-informed observers.

There were significant differences in assessments of progress to date, between critics of SSA and its defenders, between representatives of various oversight and monitoring groups, and within SSA management. It should be noted that while SSA claims to have made great progress in solving some of its problems, much of that progress appears to have been made within the past 6 to 9 months, while this study was underway. For example, SSA has recently shown signs of moving to improve management procedures and to change its corporate culture; it has initiated new training programs, recruited highly trained new programmers, started new management planning activities, and consulted outside experts. Some of the skeptics may not be well informed about developments during that period. At the same time it should be noted that all of the information about these developments necessarily comes from an interested party, i.e., SSA management.

Staff Reduction

Among Administration goals for SMP (cited earlier in this chapter) was increased productivity, for which work force reduction is often used as an indicator, although it is an input measure and not an output measure. In its 1986 budget request SSA formally announced the plan proposed earlier by OMB to reduce the work force by 17,000 full-time equivalents (FTEs) or 21 percent of its 1984 staff, by 1990. This was to be achieved largely through systems modernization and privatization of some activities.

GAO concluded in March 1986[17] that the agency was "essentially on target with its planned cumulative FTE reductions." In part, however, this resulted from the fact that expected increases in agency workload did not materialize (e.g., anticipated inquiries about taxation of benefits); work-year savings from systems and procedural changes were 24 percent less than expected. GAO reported (on the basis of SSA performance data) that claims-processing times and backlogs decreased.

GAO said that "the evidence is inconclusive" as to the effect on service to the public. Union representatives and field office personnel said (both to GAO auditors and to OTA) that service declined; they reported longer waiting times, a "less caring attitude" on the part of employees, and increased error rates. SSA said that service improved, but GAO said that SSA performance data was incomplete. For example, SSA does not collect data on waiting times for clients, or on client satisfaction.

SSA Claims

SSA managers point to the SMP as the first long-range, dynamic plan for meeting SSA's information-processing needs, and say that the goals and strategy of the plan are now closely integrated into operations. The Acting Commissioner, as early as 1983, claimed significant benefits from the plan, in terms of decreased processing time and other quantifiable output measures.[18] In addition, she spoke of "qualitative enhancements," including a general rationalizing of SSA procedures.

SSA points to a number of surveys of both the general population and beneficiaries, which indicate that the public continues to hold SSA service in high regard, as both courteous and efficient. In a GAO survey, 78 percent of a sample of SSA clients rated service as good or very good, and only 7 percent said it was poor; 51 percent said its performance was somewhat or much better than that of other agencies.[19]

SSA's top managers argue that SMP is a complex, multifaceted program that is now institutionalized within SSA and has had a pro-found impact on SSA's organizational culture. They point to a number of initiatives not described in SMP documents that are vital to its efforts at renewal. Among these efforts are:

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[17] U.S. Congress, General Accounting Office, *Social Security: Actions and Plans To Reduce Agency Staff*, briefing report to congressional requesters, HRD-86-76BR, March 1986.

[18] Prepared statement of Acting Commissioner Martha A. McSteen, U.S. Congress, *Social Security: How Well Is It Serving the Public?* Hearing Before the Special Committee on Aging, U.S. Senate, 98th Cong., 1st Sess., Nov. 29, 1983, pp. 8-12.

[19] U.S. Congress, General Accounting Office, *Social Security: Quality of Services Generally Rated High by Clients Sampled*, HRD-86-8, January 1986. The report also noted, however, that 18 percent found SSA mail difficult to understand, 30 percent found explanations unclear or "somewhat clear," and 58 percent had some negative comments about SSA service (e.g., long waiting times, many telephone busy signals).

- development of a strategic planning function that will drive the development of information technology;
- enlargement of training programs in the systems area to assure that new software tools receive wide acceptance and new standards are actually utilized; and
- development of new ways of handling conflicts between operations and development, disagreements among organizational subunits, and organizational conflict.

Whether these three points represent current determined efforts, aspirations to be tackled at some future time, or merely lip service paid to critics, cannot yet be determined. Privately, some SSA observers say that they depend entirely on the attention and insistence of a few key people and that they began to fade as soon as it was learned, in early 1986, that a change in top leadership and in internal organization is to occur. Whether or not this is accurate, the future strength of these essential conditions will depend in large part on the policies and the capability of the new Commissioner.

Critics of SSA and SMP

Many critics of SSA are convinced that SMP will fail, not because of the technology nor the ambitious objectives, but because of SSA's "organizational culture," its long history of mismanagement, interference from outside, political pressures, and its sheer size. Those who have generally been critical of SSA in the past are usually skeptical of the possibility of SMP improving agency performance. Past supporters of SSA tend to be optimistic about SMP.

The strong critics include some former managers brought into the agency in the late 1970s and early 1980s, who failed in their efforts to change information processing at SSA; as well as outside observers not associated with the agency directly but familiar with its problems and critical of its behavior. Two other kinds of critics are noteworthy: higher monitoring authorities in the executive branch, officials of OMB and HHS; and Members of Congress and staff concerned with SSA oversight, who have come to distrust its statements over recent years.

Many of the most adamant critics, however, admit that their knowledge of events at SSA is outdated by 12 to 18 months, so that they have no direct knowledge with which to evaluate SSA's strong claims of recent progress. The critics' positions should be viewed in the context of SSA's statements, summarized above.

One of the major themes of critics was that SSA as an organizational culture was incapable of bringing about the kinds of change represented by SMP, because of the hostility of SSA management to newcomers and the fact that powerful SSA senior managers are recruited from within, and promoted up the ranks, in long insider careers. While this creates loyalty and dedication, it also creates a strong antipathy to criticism, however well meant, and often an inability to learn from it. Critics felt it also creates a culture that does not value innovation, and as a result, outside consultants and advisors are ignored or avoided, and internal conflicts are resolved in favor of those who resist change.

SSA as an organization is said by the critics to lack a modern, analytical approach to management problems. The early decision in SMP to salvage 65 to 70 percent of the 10 million lines of COBOL code, for instance, never had any analytical support, it "was drawn out of thin air." An SSA contractor complained of having "our work ignored. They [SSA managers] steer us away from important problems." Contractors complain of slow decisionmaking, fallback of up to 2 years in the SMP schedule, and sluggishness because of the sheer size of SSA. As one noted, "there isn't a club big enough to beat SSA. Below the level of Commissioners you can't get an answer from anyone." Many critics describe an alignment of internal interest groups opposed to change.

As a plan of action, SMP is widely perceived to:

- be primarily oriented towards hardware acquisition, and
- fail to provide a vision of how SSA will do business in the future.

A continuing theme of SSA critics is that the in-place systems personnel are a principal impediment to successful implementation of SMP. A former employee notes that "in-place systems workers have impeded efforts to reform systems and have a stranglehold over new projects."

Many SSA employees are critical of the implementation of SMP. For example, the (AFGE union) *Local 1923 Report* has carried a number of stories about the failure of SSA to bring workers into decisions related to SMP, and to require that managers be trained along with workers in the new techniques and procedures necessary with the modernized systems. The union newsletter of March, 1986, commented:

> . . . in the whole SMP, not a dime has been spent on the process of managing the human side of change in (Operations). If the right questions don't get raised, if the necessary dialogue and consideration of reality and quality are not brought into the process, SSA will never have an adequate system for building the data processing system on which so many Americans depend.

Leaders in the Local welcome the new emphasis on training, but are critical of some of the ways it is being carried out. They claim that training opportunities have been determined by generic job type rather than by the individual's needs, that there is little or no opportunity for project teams to be trained together, that there is little or no training in how to manage projects using new technology, and that managers have received, at best, only cursory training about the new technology and that where such opportunities have been offered, managers have been reluctant to attend.

On the other hand, outsiders frequently perceive that SSA is spending too much time and resources on retraining employees rather than hiring new young workers from outside. One vendor notes:

> Imagine what it's like—everyone started out there and ends up there. Bank systems people come and go, insurance and airline systems people switch jobs frequently. But not at SSA. They never get new ideas and procedures carried in on the backs of people.

How Well Has SSA Performed?

SSA's performance in the first years of SMP looks considerably more promising than many of its critics will allow. There remain major hurdles to be surmounted if success is to be achieved. But the struggles that SSA is having in modernizing its systems are not unique; they are similar to problems that other large organizations in both the public and private sector have had, or are now having.

The history of the Social Security Administration illustrates some general principles of organizational behavior. Organizations do not innovate in areas of strategic importance unless there is some substantial environmental change; they innovate when they are driven to it by serious and persistent problems or by crises. In nearly all organizations, there are substantial forces resisting change, rooted in prevailing values, norms, and interest groups. Organizational innovation must involve more than adopting new technology. To use it effectively requires changes in habits, behavior, values and norms, and power relationships. Technological change nearly always brings fights over who gets, and uses, the technology to what purposes. Effective managers can take advantage of external circumstances to solidify power, disarm internal opposition, and tilt the internal conflict among groups towards successful use of the technology. Ineffective managers may be thwarted by those who quietly but stubbornly refuse to adapt work processes and procedures to make use of new technological capability.

The problems that SSA faced and faces in innovating are particularly difficult. Few private firms have a business environment of comparable size, complexity, or operational demands. The few private firms that have achieved the level of software sophistication needed by SSA, or that have successfully integrated all elements of their systems development, deal in much simpler environments. Large organizations operating in complex environments, such as multidivision companies, typically have a hodge-podge of systems developed at different times by different people and using different languages. This is the case, for example, with General Motors, which is trying to pull together its many data processing "baronies" and expects this effort to take a decade to accomplish. Some other large government agencies, such as IRS, have, in undertaking systems modernization, made mistakes or suffered problems that for a time seriously compromised their mission.

It seems clear that SSA has been handicapped in undertaking the SMP by the aftereffects of years of instability or lack of experience in its top layer of leadership, an organizational culture that emphasizes reliability and regularity in daily operations but resists change and innovation, failure to attract and hold new recruits in some critical professional categories, and most importantly by the immense size and complexity of the operations. Because it is a government agency, it had little control over changes in its services or the volume of its operations, and was not free to take risks in technology investments; at the same time, as a government agency, it and its managers are insulated against the full penalties of failures and of unproductive behavior, and some of that behavior is allowed to persist.

About some of the basic decisions and strategies in the plan itself, there is room for considerable doubt and debate among systems experts. However, for the most part these are areas where there are no clear and certain "right" answers, and almost any decision would have vigorous critics.

As will be seen in the case history, in Part III, some of the greatest hurdles that systems modernization at SSA face are not deficiencies in the plan but long-ingrained suspicions and hostility between operations components and systems development components, between newcomers and oldtimers, and between career people and political appointees, all of whose efforts will be necessary if modernization is to succeed.

IMPERATIVES FOR SSA

The opportunities for improvement in SSA's management of information technology in the next few years would be enhanced by:

- pacing work force reduction to match real gains in technological capability; i.e., avoiding abrupt reductions that disrupt or threaten smooth operations and produce excessive resistance by workers and managers to further automation;
- a period without major changes in SSA programs and administrative responsibilities, or, if such changes are mandated, provision of ample time to plan and implement the changes;
- absence of major reorganizations other than those that reflect and support rationalization of the work flow to accommodate changes in processing systems;
- enhanced capability to recruit competent and well-trained systems designers, managers, and programmers (which probably depends now on pay and classification schedules);
- continued funding for SMP itself, and for SMP-related support functions, such as technical and management training;
- strong commitment by top leadership to achieving the goals of SMP and to building a cooperative relationship between managers and workers;
- insistence by top leadership on real cooperation between operations and systems development personnel;

- an emphasis on continued strategic planning, and assurance of resources dedicated to this activity; and
- early resolution of the issue of independent agency status for SSA.

These desirable conditions imply certain responsibilities for SSA leadership, for the Administration, and for Congress. For all parties, they would require placing long-term objectives ahead of the desire for immediate realization of the benefits sought through systems modernization. Congressional oversight will be most effective if it is directed toward insisting that the agency and its executive branch monitors strive to create the necessary conditions for progress, rather than focusing on assignment of blame for problems in the past.

SSA is changing as SMP is implemented, although these changes may not be quite as rapid, nor as deep and smooth, as SSA suggests. Most congressional staff people have not had the opportunity to be well informed about recent and current progess in SSA. SSA's excessive defensiveness, attempts to deny any and all failures, and resistance to outside advice encourages its critics to suspect and expect the worst. In the past, there has been strong tension between the institutional drive to secure the resources to make much needed changes, and the defensiveness of those people who are struggling to cope, not always successfully, with day-to-day problems. This has at times distorted or obscured the picture that is presented to Congress. These distortions—whether in the past or in current efforts to rewrite history—are now important chiefly to alert Congress to the need to probe deeply and target questions carefully in order to assess reliably the degree of improvement in service delivery. Much improvement is clearly possible through the use of new information technology, and is the best way of justifying the significant resources invested in SMP from 1982 to 1990 and beyond.

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Chapter 3

Systems Modernization and Related Issues, 1986-90

The likelihood of success in systems modernization for the Social Security Administration depends in part on the support of its employees, its clients, its overseers in Congress, and other institutions with which it interacts. To the extent that SSA succeeds in modernizing both its information systems and its management, this will change the way the agency does its business, and will affect its relationships with Congress, its clients, its employees, and with other institutions, such as State government. This chapter explores some of these relationships now and in the next 5 years.

It surveys, first, two issues in SSA's relationship to Congress: the monitoring and oversight of SSA, and SSA's ability to respond effectively to changes mandated by Congress in social security programs, coverage, and benefits. Next it considers SSA's relationships with its own employees, in the context of systems modernization. Third, it considers SSA's response to a major Federal initiative, improved debt collection and financial management, which significantly affected SSA relationships with its clients.

Fourth, the chapter discusses SSA relationships with the Administration and with the private sector, in terms of possible major changes in SSA's status, such as making it an independent agency, or privatizing part of SSA operations. Finally, the chapter looks at a growing issue in SSA's relationships with the general public: concerns about the confidentiality and security of data as affected by advanced information technologies and current practices of data-sharing and computer-matching, capabilities that are likely to be facilitated by systems modernization.

SSA AND CONGRESS: ACCOUNTABILITY AND RESPONSIVENESS

Monitoring and Oversight of SSA

SMP has already had both positive and negative impacts on SSA relations with Congress and the White House. SMP has been regarded by most Congressmen as good news and Congress has responded with generous funding. However, there is continuing concern over the wisdom and cost-effectiveness of some of the basic SMP decisions, and over SSA's procurement procedures. In addition, there is congressional concern over whether SMP-related employment reductions and office closings will result in poorer service to clients. Congressional oversight committees have been particularly critical of SSA's apparent lack of assessment of the impacts of systems modernization on service levels. Finally, there have been serious charges of irregularities and improprieties in at least one SMP contract award.[1]

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[1] U.S. Congress, *Hearings: Contract Irregularities and Mismanagement Plague SSA's Systems Modernization Program*, Legislation and National Security Subcommittee of the House Committee on Government Operations, Nov. 6 and Nov. 20, 1985.

Recently a General Accounting Office investigation alleged that the Commissioner who initiated SMP, John Svahn, improperly allowed employees of his own former employer, Deloitte Haskins & Sells (DHS) to use SSA office space next to his own office for a number of months just when SMP contracts were being developed, in which DHS had an interest as potential contractors. Svahn was also accused, along with other SSA employees, of improperly accepting restuarant meals from Deloitte Haskins & Sells during this period. Deloitte Haskins & Sells, a Big Eight accounting firm, has since become the largest subcontractor in the SMP Program and was a major force in recommending EDS as the major integration contractor.

Because of SSA's size and importance, and the large share of Federal expenditures that it administers, a small army of people is committed to monitoring and auditing SSA to assist either Congress or the Administration in oversight. A significant amount of SSA management time is spent in answering detailed requests for information from oversight bodies. SMP has added to the volume and complexity of these activities.

There are inherent difficulties involved in congressional oversight of a program like SMP. Several committees have an interest in different aspects of it. The House Committee on Government Operations maintains a stern eye on information technology procurement and other aspects of its management. The House Ways and Means Subcommittee on Social Security has broad responsibility for administrative performance, but does not have the technical expertise to evaluate information systems and their management. Other committees focus on service delivery, and the interests of special groups in society such as the aged and disabled.

This tends to separate consideration of technological issues from consideration of service quality issues. In addition, the critical problem of software development or procurement has probably received less attention than other aspects of information technology use and management.

The difficulty of achieving effective oversight is one factor in a growing movement to split SSA off from the Department of Health and Human Services (DHHS) and make it a separate, independent agency. (This option will be examined further below.) Many Congressmen and staff people suspect that they do not get complete or accurate information from SSA about its resource needs, particularly on questions of its ability to respond effectively to changing legislative mandates and changes in benefits programs, because the agency's answers must be "vetted" through DHHS and the Office of Management and Budget (OMB), which may manipulate them to suit the Administration's policies and priorities (i.e., budgetary control). Thus emerging problems like those of the 1970s can become unmanageable before Congress is able to come to grips with them.

Some political scientists and some computer enthusiasts have argued that computer technology will facilitate congressional oversight by making information more readily available, and by allowing Congress to demand reports tailored to its oversight needs. However, it appears at least equally likely that computerization of data may make oversight more difficult. In the short term, it is very difficult, for example, to compare SSA's performance today with that of several years ago; as work is reorganized and automated, measures of performance have necessarily been redefined. More importantly, and in the longer term, oversight becomes more difficult because administrative decisions become more highly technical and involve issues of technological capability, multiyear investments, and systems management strategy that laymen—which includes most congressional representatives and their staff—find difficult to understand. Seeking and comparing the judgments of technical experts and working to comprehend these evaluations is extremely demanding of time, effort, and attention; it is all the more difficult because systems experts constitute a highly concentrated community of people with a great many potentially overlapping vested interests in the actions of SSA, a major purchaser of computer systems.

The temptation—some would argue, the duty (given the imperative of administrators for institutional survival and maintenance)—to select and manipulate data related to organizational performance when justifying programs and budgets, is and has always been strong for agency officials. When those budgets include multiyear and no-year investments in equipment for which a favorable return on investment is years away, and for which there are many irreducible uncertainties in cost-benefit analysis, that temptation is much stronger. When the performance data is embedded in voluminous computerized databases and can be endlessly recategorized, combined, and disaggregated by sophisticated management information systems, it becomes much easier to present a favorable picture—or an unfavorable one, if the object is to demonstrate a need for further modernization of systems.

Thus the task of oversight of a huge organization whose mission performance is entirely dependent on advanced technology that is seemingly describable only in esoteric language, becomes much more difficult.

This difficulty is also a problem for agency officials, who must struggle to explain their technological resource needs to congressional committees in ways that do not oversimplify and distort them and yet do not conceal the technological and administrative problems involved in meeting congressional mandates. Responding to a large volume of oversight inquiries also reduces the time that administrators can spend in solving problems within their organizations.

SSA's Ability To Implement Changes Mandated by Congress

Social Security as a national program was born in a period of strong party cleavages over having such a federally managed function in our society, but over the next five decades, social security achieved a virtually nonpolitical and bipartisan status. Since the late 1970s, however, there have been a series of debates over the size, scope, and organization of Social Security. It is likely that this debate will continue during the next 5 years, both before and after the 1988 elections.

Some believe that current budget deficits and economic limitations make it essential to cut back on the system of Federal retirement, disability, and welfare programs. Suggested solutions range from turning social security over to the private sector or creating a worker option to select among competing private and public retirement plans, to cutting programs back in scope, benefits, and costs. Others see the Federal program of retirement, disability, and income-support as the hallmark of a just social order and seek to expand social security into areas such as national health insurance, a wholly nationally administered disability program, or a Federal program for covering catastrophic health care of the elderly. These positions are not necessarily related to party affiliation. Some additional responsibilities have been considered for SSA; for example, a role in proposed immigration regulation.

Most national policymakers, however, probably expect that Social Security will be maintained generally in its present form during the next 5 years, with at most some relatively minor changes in programs or some realignment of SSA's various administration responsibilities for non-SSA programs. The spectrum of possible changes that might be required of SSA, ranging from no change to radical change in agency status, and their relationship to SMP, are discussed below.

Moratorium on Program Changes or Adjustments

One option is to conclude that SSA needs a breathing spell in its operational and systems-development work. As recently as September 1985, a GAO report concluded that SMP software development was not yet improving SSA's ability to implement legislative changes in programs,[2] although this may no longer be true, since SSA has at least reduced or eliminated most of its backlogs. It has been suggested that Congress avoid making changes for the next 2 years, or until systems modernization is further advanced.

This option is not likely to be acceptable to those who believe that substantive changes are necessary. As one experienced congressional aide put it:

> We gave SSA a huge bundle of money for SMP precisely so that it could handle the changes that Congress is going to make in basic social programs. We expect the agency to keep up with us; that's what "modernization" is all about.

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[2] U.S. Congress, General Accounting Office, *Social Security Administration's Computer Systems Modernization Effort May Not Achieve Planned Objectives*, GAO/IMTEC-85-16, Sept. 30, 1985.

Another aide added:

> We don't forego tax reform because IRS may have computer problems, and we aren't going to lose timely opportunities to improve social security just because SSA has a backlog.

It should be noted that SSA has not asked for such a legislative moratorium. The agency says that progress with SMP has already significantly increased its capacity to fulfill legislative directives.

Program Simplification

Major and minor program simplifications are possible that could make both computer and field operations easier; for example, simplification of the formulas for recomputing benefits or changes in the earnings test for eligibility. SSA has been working for several years on concepts for formula readjustments to simplify benefits calculations, but is not ready to suggest them. One problem is that they might require compensatory or transition payments to soften the losses to various categories of beneficiaries. Proposals for program simplification changes may however surface in the next 5 years.

Program Modifications

Several congressional and administration sources provided a "shopping list" of program modifications that various interest groups or Members would like to see enacted. These included restoring eliminated benefits to student dependents of deceased, retired, or disabled workers; expanding retirement coverage to State and local employees; including partial disability under SSA coverage or expanding rehabilitative or work-reconnection efforts; addressing women's equity problems through measures such as earning-sharing between husband and wife; and correcting the "notch" or "inequity" problem that arose between beneficiaries born pre- and post-1916, as an unanticipated consequence of formula changes made by the 1977 amendments. Such new or expanded programs would produce a temporary burst of additional work to make necessary changes in benefits formulas, and might delay ongoing redesign of processes or require further redesign. Each proposed change should be carefully studied in advance to determine what resources SSA would need to make the changes, in the context of already scheduled work force reductions.

One major program change recently under discussion is that of complete federalization of disability programs, instead of the current arrangement under which States make disability determinations.[3] State determination of disability (Disability Determination Services, DDS) shows great variability in quality and accuracy, in procedures and organizational structure, and in physician participation. In the recent effort to purge disability rolls (see below) some States refused to do reexaminations under SSA guidelines. GAO has advised the Congress[4] that:

> From a purely operational perspective, a totally federal structure for disability determination appears to be the preferred option.

It would give SSA direct control and accountability; eliminate State political influence; provide greater organizational uniformity; assure standardized salary and qualifications for personnel; eliminate the time spent in negotiating with States on compliance; allow closer working relationships between district offices and determination units; and allow SSA to select the number, location, and size of offices.

GAO has advised Congress that federalization of determinations would be likely to add a large number of employees to Federal rolls (11,000, according to GAO assumptions about productivity). It could also cause the loss of some trained and experienced examiners who chose not to work for the Federal Government, and would make the determination process vulnerable to Federal hiring freezes or other budgetary measures. Claims processing might be disrupted during the changeover period, and a new policy and system for purchasing medical services might have to be developed.

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[3] Under the Disability Insurance Program of 1954 and the Supplemental Security Income Program of 1972 Congress mandated State responsibility for determinations of disability, with oversight by SSA.

[4] U.S. Congress, General Accounting Office, *Current Status of the Federal/State Arrangement for Administering the Social Security Disability Programs*, Report to the Honorable Jim Sasser, U.S. Senate, HRD-85-71, Sept. 30, 1985.

GAO did not address the possibility of incorporating the determination process into existing SSA field offices, rather than maintaining separate facilities; thus it did not speak explicitly about the effects of federalization of the process on the level of demand on SSA computer and telecommunication systems, or the effect of these systems capabilities on productivity of determination examiners and support personnel. These questions would have to be addressed in further analysis of the effects of this program change on SSA technological and personnel resources, and on the quality of future disability determination services.

Non-Social Security Program Developments

SSA could be asked to take over administrative responsibilities for new non-SSA programs, as has happened repeatedly during its history. Under national immigration reform, for example, employer access to SSA for verification of job applicant identities could be mandated. If SSA were given this role, there would be pressure to enhance the accuracy of SSA records, such as matching accounts with death records to detect invalid accounts, and identifying accounts used by more than one person. This could represent a significant volume of additional work for SSA, especially without an integrated database in place; it would probably require the development of entirely new software systems.

SSA AND ITS EMPLOYEES: LABOR-MANAGEMENT RELATIONS

SSA began its SMP with hostile labor relations, in large part due to the deteriorating working conditions and heavy overtime demands of the 1970s. In the early 1980s labor and management refused to negotiate a contract for 18 months, and ultimately accepted some compromises (December 1981) only with great bitterness on both sides. Since then, the union has filed up to 800 unfair labor practice charges each year. Until 1983, the labor relations management of SSA would not even call the union, for fear of being misquoted or maligned.

Both SSA and its union agree that SMP will lead to new levels of productivity. The question is whether this will be used to enhance service levels, improve the quality of worklife, and raise the skill levels of workers; or whether the productivity gains will be used solely to reduce the size of the work force, speed up work, and lower skills requirements and status of jobs.

This debate is not merely between SSA and the union. Also involved are Administration policies, congressional interests, the stakes that other unions have in office automation issues, the interests of SSA's contractors and vendors and those who would compete for awards if SSA operations were contracted out, and the interests of those who depend on SSA's services—the beneficiaries.

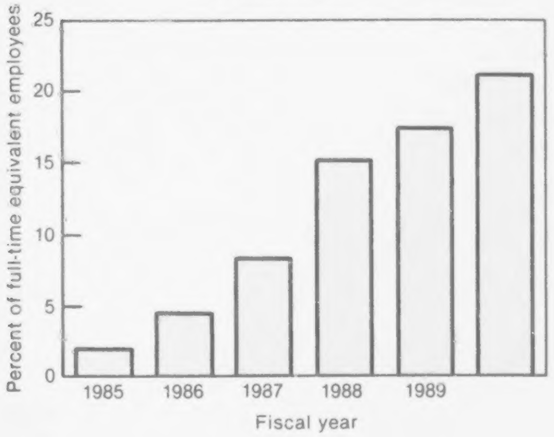
The relationship between the union and SSA is buffeted by the maneuvering of all of these parties. OMB pressure on SSA to drop 17,000 employees over 6 years, and to privatize operations equivalent to 8,600 jobs, as discussed below, are good examples. As SSA managers readily acknowledge, in the recent past, only the extraordinary efforts and commitment of SSA workers have allowed the agency to surmount repeated crises in its operations. But SSA must of course respond to the Administration and Congress as they look for a return on what will by 1990 be the billion dollar investment in SMP. Under these circumstances the management is under great tension, and many employees are resentful and suspicious.

A union official estimated as early as mid-1984, that SSA workers were facing a net reduction of 10,000 field office jobs, one-third of this work force, with virtual elimination of the position of data review technician and changes in the claims representative job (some managers were calling for its elimination and replacement by clerical staff).[5]

These expectations proved justified; the net job loss in 1985, as reported by SSA field offices to GAO, was 949 full-time equivalent jobs, or 2.4 percent of all 1984 jobs[6] (see figure 6). This included 297 data review technicians, 275 clerical positions, 329 claims representatives, 86 service representatives, and 140 nonceiling employees or other positions. This was a total of 1,127 jobs eliminated, but 178 "other positions" were created, including 123 joint data review technician/service representative positions.

On the other hand, it was also predicted that many of the 1,386 SSA field offices would be closed. SSA is reviewing the status of these offices, but as of February 1986, the 228 reviews that had been conducted had not resulted in any closings.

Figure 6.—Cumulative Percentage Reduction of Full-Time Equivalent Employees From 1984ᵃ to 1990 in the Social Security Administration Staff by Fiscal Year



[a] In 1984 there were 83,588 employees in SSA.

SOURCE: U.S. Congress, General Accounting Office, *Social Security: Actions and Plans To Reduce Agency Staff*, USGAO/HRD-86-76BR, March 1986.

Under the Civil Service Reform Act (CSRA), management retains the right to introduce new technology and to change jobs and work methods. The union cannot force SSA to bargain on technology adoption or work standards. But the CSRA does require management to announce its plans and give the union an opportunity to bargain over the means and conditions of proposed changes. The union can force management to pay attention to working conditions, health and safety concerns, retraining, skill levels, and job classification.

Some observers say that this gives the union a way to slow down, impede, and even prevent SMP from proceeding if it so chose, at least long enough to stir up the ire of Congress and the public and bring the whole project down. On the other hand, the union has not opposed new technology nor does it want SSA to fail. Workers have generally not complained about the advent of new technology; rather, they complained about the terrible workloads imposed by new programs for which the agency was unprepared, the lack of technology with which to handle this workload, and the demands on workers to work overtime.

These tensions led management and labor to try a new approach, in the common recognition that both union and management need to make SMP a success. In 1985 SSA and the union reached an unusual agreement, which mirrors the recent agreement between the UAW and General Motors in GM's Saturn Car Division in Tennessee. The similarity is more than superficial; key advisors to SSA and the American Federation of Government Employees were also key advisors to UAW and GM.[7]

"The Joint Statement of Common Purpose," was signed at SSA in September 1985. Its objectives are to avoid the degradation of work, to enhance the quality of working life, and to create a three-tiered management-labor structure for future shared decisions. It explicitly avoids trying to change the statutory requirements of the relationship between management and labor, although the CSRA did not envisage labor-management cooperation at this level. In other words, the agreement will permit both collective bargaining and cooperation of a new kind.

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[5] According to a letter from John Harris, Special Assistant to the National President of the American Federation of Government Employees (AFGE), July 1984.

[6] U.S. Congress, General Accounting Office, *Social Security: Actions and Plans To Reduce Agency Staff*, briefing report to congressional requesters, HRD-86-76BR, March 1986.

[7] They were: Irving Bluestone, retired Vice President of UAW; and Dutch Landon, retired Quality of Work Life Director at General Motors.

As the union president described the agreement:

> . . . both sides put away "business as usual" and go into a partnership, a joint action based on common interests and objectives, to look at what is going to happen to the workplace, the work, and the worker as this automation is brought about. . . . [W]here collective bargaining is the best remedy to the problem, we shall do it. But we will seek in the main to solve our problems together as co-equals and not as adversaries.[8]

The three-tiered structure consists of an executive committee level (which will include the SSA Commissioner and the head of AFGE), a project level, and a workplace level.

The Joint Policy Committee agreed on the following guidelines:

- the process (development, implementation, and oversight) will be joint and co-equal,
- employee participation at the workplace level will be completely voluntary,
- innovations that result from the joint process will not result in the loss of job or pay of any employee,
- the joint process is independent of the labor agreement and is not a replacement for collective bargaining or the grievance procedure,
- training and resources will be provided,
- the joint process will not be used as a bargaining chip, and
- either party may withdraw from the joint process.

The policy committee chose three projects to work on immediately; including the effects of the claims modernization process, issues related to use of visual display terminals (VDTs), ergonomic furniture (i.e., desks and chairs specially designed for comfortable support while working), and related workplace issues. Each of these projects was to be developed by a project team with links to working teams of management and labor at the operating level, and to make recommendations to the policy committee.

Most observers feel that the success of this agreement is essential to carrying out SMP. But in spite of the agreement, the union expects "displacement and disruption to be the norm in the implementation of SMP." A union official notes that:

> A rupture of the work force such as widespread job loss or reassignment can be avoided. But only if a comprehensive program is adopted to re-design field offices, one which starts with the premise that all workers will be given useful jobs with similar skills or will be retrained and no one will be laid-off or downgraded. With such a program the phasing in of automation will be conducted with the worker in mind, not as an after-thought. . . . *This is the greatest challenge to the union and management because it puts both into a new relationship at a time when neither trusts the other.*[9] (Emphasis added.)

It is clear, however, that this objective, interpeted literally, conflicts directly with the objective of reducing the work force to justify investment in information technology. The joint agreement could in theory provide a mechanism for compromise on this issue while cooperatively working toward other goals such as improved quality of the workplace. But by May of 1986 the joint agreement appeared to be breaking down. According to workers, announcement of appointment of a new commissioner weakened the influence of managers who supported the mechanisms and thereafter there were no meetings of the committees. Union members believe that the appointment signals a new determination by OMB to force drastic job eliminations, and they charge SSA managers with "passive acquiescence."

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[8] Letter of Kenneth Blaylock, President, to the union locals, June 3, 1985, quoted by permission.

[9] Harris, letter, op. cit.

SSA AND ITS CLIENTS: ISSUES OF DEBT COLLECTION AND FINANCIAL MANAGEMENT

SSA's relationships with its clients, and its public image, have been adversely affected by its response to the government initiative for improved debt collection and financial management. As information technology allows the agency to become more efficient in this area, more judicious management techniques will be necessary to avoid unnecessarily eroding the trust that beneficiaries still have in the agency's operations.

In 1981, the President ordered tough enforcement of the Disability Amendments Act of 1980, which led to summary termination of over 1 million disability beneficiaries, causing a huge backlog of work for SSA. Rigorous enforcement, by the Administration, of this act and the later Debt Collection Act of 1982 subjected SSA to bitter criticism in the press and among its constituents and traditional supporters. Continuing and future efforts to improve debt collection and financial management, and reduce fraud and waste, are likely to be affected by the resentment that resulted from this initiative.

During this period the political climate for SSA was complicated by the fact that the two Houses of Congress were controlled by different parties, and thus oversight committees emphasized somewhat different priorities and directives. Members of some oversight committees were pressing for greater assurance that service levels would be improved as a justification for investment in systems modernization. Members of other committees wanted greater assurance that no effort was being spared to reduce costs. Members of both parties and both Houses emphasized the need for better management, greater efficiency, and strict accountability. These pressures affected SSA's response to the President's initiative, at a policy level; at the operational level, there were further difficulties. While the Disability and Debt Collection Acts were increasing the workload, a hiring freeze was imposed on SSA, as well as other agencies, in 1982.

Under Public Law 96-265, Social Security Disability Amendments of 1980, the Secretary of HHS was required to review the status of all nonpermanently disabled DI beneficiaries every 3 years, beginning in 1982. Until then SSA had reviewed only a small percentage (about 150,000) each year, primarily those expected to recover from their disability and those voluntarily reporting either improvement or gainful employment. But GAO had estimated that as many as 20 percent of those on the rolls might not meet the legal definition of disability.[10] The Administration therefore ordered stringent actions to purge the rolls.

In order to spread the workload on the States (which make the original disability determinations), SSA began implementing the reviews 9 months earlier than the statute required. Of 1.2 million cases reviewed, 500,000 beneficiaries were summarily dropped from the rolls. This brought about a flood of protests and appeals, which only increased when 200,000 of the 500,000 were reinstated by appeal to administrative law judges, the first level of appeal. Many congressional hearings were held to consider these developments.[11]

Those who had been dropped from the rolls stopped receiving benefits, until Congress passed stopgap legislation in 1982 (Public Law 97-455) to allow them to continue receiving benefits while they appealed. About two-thirds of those who had been dropped from the DI rolls were eventually reinstated. The courts, and the

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[10] For background, see Social Security Administration, Office of Legislative and Regulatory Policy, *Social Security Disability Amendments of 1980: Legislative History and Summary of Provisions*, Social Security Bulletin, April 1981; and "Social Security Disability Benefits Reform Act of 1984: Legislative History and Summary of Provisions," Social Security Bulletin, April 1985 (both listed as SSA Pub. No. 13-11700); HHS News Release of Apr. 13, 1984, no title; and *New York Times*, Dec. 6, 1985.

[11] Most recently: U.S. Congress, *Government Representatives: Advocates or Adversaries?* Hearing Before the House Select Committee on Aging, 99th Cong., 1st sess., Mar. 18, 1985, Boston, MA.

States, raised serious concerns about the criteria used for "medical improvement," and especially the criteria used in mental impairment cases and in evaluation of pain. The Administration adopted a policy of "nonacquiescence" in certain cases; in other words, SSA would not apply court decisions about its criteria and procedures in other judicial districts but defended its practices district by district, case by case. (This policy was rescinded in early 1985.)

By 1984, the disability review process had all but collapsed, with half of the States either refusing to administer the reviews or under court order not to do so. In April, HHS Secretary Margaret Heckler ordered suspension of the disability reviews "until new disability legislation is enacted and can be effectively implemented." She also ordered SSA to resume benefit payments to those in the process of appealing.

SSA had suffered a severe blow to its esteem with the public. An internal SSA memo acknowledged that "the agency's credibility before the Federal courts is at an all-time low." The official SSA position is that the harshness of its administration of the amendments was inadvertent and a startup problem; it says:

> . . . a great many administrative changes were made beginning in 1982 to deal with these criticisms. Thus the disability legislation as finally enacted, in 1984, reflects, in part, the evolution of the CDR administrative process since 1981.[12]

The congressional response to the problem was the Social Security Disability Benefits Reform Act of 1984 (Public Law 98-460). It permits termination of Disability Insurance benefits only if there is "substantial evidence" of medical improvement sufficient to allow the beneficiary "substantial gainful activity," or new medical evidence that vocational therapy or technology makes him or her able to work, or that the original impairment was not as disabling as it was originally considered, or the original determination of eligibility was in error.[13]

In 1983, similarly tough enforcement of the Debt Collection Act led to withholding all social security payments to beneficiaries who had received overpayments, as opposed to the accustomed procedure of withholding no more than 25 percent of benefits until overpayments were repaid. In addition, the U.S. Treasury used direct electronic debiting of beneficiary bank accounts with no prior notice ("Treasury recovery"). This could seriously jeopardize recipients with no other resources.

These actions kept telephones ringing in congressional offices as beneficiaries complained, and the flood of inquiries and protests to SSA district offices resulted in reduced attention to servicing other clients. It also caused distortion in SSA management behavior, because local administrators were given pay raises or promotions based on the amount of debt they collected.

The controversy over these enforcement procedures appears to have added to the fierceness of the controversy over systems modernization, even though there is little logical relationship between the two. Critics repeatedly point to these episodes as illustrating a commitment to efficiency at the cost of socially desirable service to the public.

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[12] Social Security Administration, Office of Legislative and Regulatory Policy, "Social Security Disability Benefits Reform Act of 1984: Legislative History and Summary of Provisions," Social Security Bulletin, April 1985, SSA Pub. No. 13-11700.

[13] On Dec. 6, 1985, the Administration announced that SSA would again begin the review of all 2.6 million disability benefits accounts. *New York Times*, Dec. 6, 1985.

SSA AND THE ADMINISTRATION: INDEPENDENT STATUS AND PRIVATIZATION

Possible Independent-Agency Status for SSA

On July 22, 1986, the House of Representatives voted 401-0 to make SSA an independent agency, as it was in its first few years of existence (H.R. 5050). This bill was referred to the Senate Finance Committee 2 days later.

Making SSA an independent agency with only the core functions of retirement, disability, SSI, and possibly Medicare was recommended by the National Commission on Social Security in 1981. The National Commission on Social Security Reform, in 1983, called for a congressional study of how this could be accomplished, and a panel headed by former Comptroller-General Elmer Staats conducted a study of this recommendation for Congress.

In June 1984, the panel outlined a design for a new Social Security agency, which would have SSA headed by a single administrator appointed for 4 years, with a nine-member bipartisan advisory board. The administrator and board would have greatly strengthened management authority, including delegated authority over personnel, facilities, and computer systems.

Hearings on the Staats Plan were held in July 1984. Support for the plan came from some influential members of Congress, AFGE union leaders, SSA local and regional office managers and pro-social-security interest groups. Opposition was registered by Acting Commissioner Martha McSteen[14] and former SSA Commissioner Ross. In late 1984 the independent agency proposal appeared unlikely to pass. But unexpected political impetus for the proposal arose in the House in the summer of 1985, in reaction to the Administration's proposed reduction in the SSA work force and the closing of some local offices.

Hearings were held on H.R. 825, a bill to make social security "off budget" and place it within an independent agency, in September 1985.[15] (The Social Security Trust Fund has since been moved off budget.) Advocates of an independent SSA argued that independence would help shield SSA from the full force of OMB's demands for a cutback and help it resist demands for excessive contracting out of work. Some hoped that the threat of such legislation would itself soften OMB pressure, since removing SSA from DHHS would take away about 60 percent of DHHS's budget and staff and leave some social programs related to core SSA functions in DHHS without coherent administration.

An "independent SSA" bill with 165 cosponsors was reported out by the House Ways and Means Committee and unanimously passed by the House in late July of 1986. (The measure is now before the Senate Finance Committee.) This Budget and Administrative Reorganization Act differs only slightly from the Staats Panel recommendations. It would separate SSA from DHHS; the agency would be governed by a three-member Board, nominated by the President and confirmed by the Senate. The board would be responsible for the Trust Fund, make budget recommendations to Congress, and make policy recommendations to Congress and the President. The members of the board would serve staggered 6-year terms, and no more than two could be of the same political party.

There would be a similarly appointed Commissioner as chief operating officer, who would serve a 5-year term, and who would be specifically charged with developing and implementing a long-range plan for advanced automated data-processing systems. There would also be an Inspector General, and a Public Ombudsman to represent client/beneficiary interests.

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[14] Former HEW Secretary Wilbur Cohen commented that her position was "that of OMB," not necessarily her own.

[15] U.S. Congress, *Back to Basics: Social Security Off-Budget and Independent*, Hearing Before the House Select Committee on Aging, 99th Cong., 1st sess., Sept. 9, 1985.

As the Staats Panel recommended, the proposed SSA would (initially for an 18-month demonstration period) have broad delegated authority over personnel management, facilities management, and ADP contracting and management. SSA would carry out only its primary programs: old age, survivors and disability insurance, and supplemental security income programs.

Opponents of independent-agency status for SSA say that it is unnecessary since Congress has now helped clarify SSA responsibilities and provided solid appropriations for SMP. SSA, they argue, needs a period to consolidate organizational changes, provide personnel stability, and restore the confidence of beneficiaries and account holders in SSA services. Cutting Medicare and Medicaid loose while access to SSA records remains vital to determinations of eligibility, would be disruptive. Taking SSA out of DHHS, according to opponents, would:

1. remove policy coherence for the different Federal social-welfare programs;
2. deprive SSA of representation and advocacy within the Cabinet; and
3. by removing essential oversight from DHHS and the General Services Administration (GSA), potentially allow SSA to drift back to its old "hardware orientation."

Supporters see independent status as a means of recognizing social security's special status as a trust program, and giving SSA management freedom from alleged DHHS interference, GSA neglect, and OMB constraints that do not accord with congressional priorities. With "extraneous" social welfare programs removed, SSA would be able to concentrate on its major programs the professional resources that have frequently been tapped to support "non-Social Security programs." A bipartisan board could concentate on long-range planning, policy development, and liaison with Congress and the executive branch, while the Commissioner concentrates on administration and information systems.

The strongest motivation for some supporters of independent status for SSA is their suspicion that information about SSA resource needs, progress in modernization, and ability to carry out congressional mandates, is filtered through executive branch agencies that want to justify budget cuts, possibly at the cost of reduced services. They argue that independent status would make possible more effective congressional oversight.

Meanwhile, the whole concept of independent agencies has come into renewed dispute as an indirect result of the Gramm-Rudman-Hollings Act and the February 7, 1986, ruling by the U.S. Court of Appeals. The Court struck down key provisions of the act on the grounds that:

> . . . the powers conferred upon the Comptroller General . . . are executive powers, which cannot constitutionally be exercised by an officer removable by Congress. . . .

This has been interpeted by some commentators as applying to independent agencies, particularly since the court observed in passing that:

> It is not as obvious today as it seemed in the 1930's that there can be such things as genuinely "independent" regulatory agencies, bodies of impartial experts whose independence from the President does not entail correspondingly greater dependence upon the committees of Congress to which they are then immediately accountable; or indeed that the decisions of such agencies so clearly involve scientific judgment rather than political choice that it is even theoretically desirable to insulate them from the political process.[16]

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[16] United States District Court for the District of Columbia, Order filed Feb.7, 1986, in Civil Action No 85-3945 and others, p. 40.

The first independent agency was the Interstate Commerce Commission, in 1887; since then a number of agencies, primarily of a regulatory nature, have been created with this status. Although executive branch agencies, they report to both the President and Congress, and their heads serve fixed terms, and can be removed only "for wrongdoing." Their constitutionality was upheld in 1933 (Humphrey's Executor). The Office of Legal Counsel, in the Department of Justice, has several times raised the issue of the constitutionality of independent agen-

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The District Court did not say that all independent agencies whose heads have fixed terms and are not removable by the President were unconstitutional. It based its ruling on the fact that the law governing the Comptroller General's removal from office before the expiration of his fixed term says that it may be done by joint resolution of Congress (for certain listed causes), as well as by impeachment, which applies to all U.S. officials. Nevertheless, this ruling, if confirmed by the Supreme Court, will probably strengthen the opposition to independent status for the Social Security Administration, a nonregulatory agency which clearly performs executive (administrative) duties. (Under H.R. 5050 both the Social Security Board and the Commissioner are to serve for fixed terms and cannot be removed by the President.)

Regardless of the outcome of this issue, the questions will remain as to:

1. the justification for giving independent status to SSA,
2. whether this would make congressional oversight more or less difficult, and
3. whether it would solve basic management problems within SSA.

Independent-agency status would not solve the problems associated with systems modernization and congressional oversight. First, some factors or constraints would remain, or be only partly removed. OMB would still exercise oversight on behalf of Presidential policies. Recruitment of expert staff would still depend on improving the professional climate for programmers and systems staff, and as civil servants they would still be subject to Federal pay scales. Legislation designed to assure competitiveness in procurement would still apply.

Secondly, Congress would not necessarily be assured of better information about SSA's information technology management, since executive branch constraints on SSA statements to Congress have not been the only factor in oversight problems, as already discussed.

It is clear from SSA's recent history that the extreme instability of leadership during the 1970s contributed greatly to SSA's difficulties in solving its internal problems; it is less clear that frequent changes in leadership (and the frequent reorganizations related to them) caused the problems. They could be viewed, alternatively, as unsuccessful efforts to solve those problems. At least as strong a case can be made that the long stability, insularity, and defensiveness of SSA's middle and upper management caused SSA to fall behind in meeting the technological imperatives with which all large data-handling organizations were struggling.

It is also clear from SSA's recent history that it has suffered from conflicts in priorities, if not policies, set by the Administration on the one hand and Congress on the other; and to some extent from conflicts in priorities of the various oversight committees. This is however a problem that is inherent in our form of government (indeed, was deliberately built into our Constitution), and it becomes acute for nearly every agency at some time or other. Independent status cannot be practical as a general solution, and in each specific instance it carries with it the risk of introducing unnecessary incoherence and irrational variation in policy formulation and administrative procedures. SSA may also have suffered from lack of a strong direct voice in Administration policymaking (since DHHS must speak for many disparate and quasi-independent components); independent status would not solve this problem but instead would worsen it.

Finally, at times, SSA communications to Congress about problems or resource needs were constrained by considerations of Administration policy and political initiatives. However, this has not been the sole source of oversight problems. SSA defensiveness and fragmented congressional oversight responsi-

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cies. Theodore Olson, who headed this office during President Reagan's first term, has filed suit challenging the constitutionality of the Federal Trade Commission. These challenges turn on the point of the constitutional principle of separation of powers and the President's inability to dismiss the heads of independent regulatory agencies although they are within the executive branch. In 1976 the Supreme Court ruled that the composition of the Federal Elections Commission was unconstitutional for this reason.

bility have also played a part, as have the inherent uncertainties in technological development. Under these circumstances, it seems that independent status for SSA would not in itself greatly facilitate the oversight process.

However, Congress may conclude that reduction of SSA's work force and/or closing of field offices at this stage of systems modernization would degrade service to clients to an unacceptable degree, or would cause the reappearance of the problems of the late 1970s, or would render SSA unable to respond satisfactorily to congressional mandates—any of which outcomes would discredit the Systems Modernization Plan and discourage further efforts to carry it to completion. In that case, independent status would be a more attractive option.

Privatization of or Contracting Out Major SSA Operations

The Administration is currently pressing executive agencies to implement OMB's policy directive, Circular A-76, instructing agencies to contract to private sector organizations those Federal operations that could be done more cheaply outside of government. In a memorandum dated July 25, 1985, DHHS directed SSA to develop a plan to contract out the equivalent of 8,600 full-time positions. Those under consideration include the processing of Annual Wage Reporting now done at SSA's Data Operation Centers; the filing and mail work done in handling SSI folders; and the operations of SSA's National Computer Center where the central beneficiary records are maintained.

There are serious management issues to be considered. It is likely that much time and money would be needed for a private firm to learn the operations and functional requirements of the SSA system. Particularly with functional requirements still poorly defined, computer services firms would incur a significant risk in bidding without assured funding up front for startup operations. Government contracts must be recompeted regularly, and any change in contractors would mean an additional learning period.

The size of the social security programs is also a concern. Relatively few contractors might be in a position to successfully deliver systems/capabilities of this magnitude; and therefore the level of competition might be low.

The union that represents SSA workers, AFGE, is of course bitterly opposed to the concept and is calling on labor organizations to oppose any such "despoiling" of the public social security system. Adding further to the strong perception of job insecurity would further erode morale among SSA employees and increase management problems.

There is a broader concern over whether the competence and the commitment of SSA's workers can be matched by those of contractor organizations. The valuable experience that SSA workers have built up over many years has often been the saving grace that allowed the agency to cope with a suddenly expanded volume of data processing or repeated systems failures. In a crisis, SSA often calls on loyalty and dedication over and above the call of duty to get the work done, and dismissal of these Federal workers now would be unwelcome to many in Congress, as well as to many SSA managers.

There are major concerns about the wisdom and long-term effects of having an essential and highly visible Federal function such as administering the SSA database in private hands. Turning over sensitive and Privacy Act protected records on 160 million Americans to a private contractor would probably be sharply resisted by bipartisan groups in Congress who see the social security system as a public trust and would not trust these records in private hands. SSA is responsible for a significant fraction of all Federal expenditures—roughly 15 percent. The question of public trust in the accountability of the Administration of these expenditures must be considered, as well as the quality of services that can be assured, when the temptations of for-profit operations are combined with the possibilities for fraud inherent in government contracting.

On the other hand, OMB and GAO have found that in many cases privatization of government services results in significant savings to the taxpayer and/or improved services. OMB Circular A-76 requires that a function that is not inherently governmental must be put into a description capable of being bid on by private companies. In some cases, the government agency is able to show that its costs for providing the services is as low as, or lower than, those in the private sector, in which case the services are not contracted out. This necessity has provided a new and powerful incentive for government agencies to make their operations cost-effective.

SSA's management maintains that applying Circular A-76 to SSA operations will not necessarily result in contracting out these services, because the systems modernization has, or will eventually, make the agency's performance so highly efficient that SSA could become the lowest possible bidder. SSA officials profess not to believe that they would lose a competition for carrying out their data center, program service center or National Computer Center operations, and thus do not see the requirement of conducting an A-76 exercise as leading inevitably to contracting out. Some observers, however, fear that some companies in the private sector, paying low wages and anxious to get SSA operations as a high-visibility advertisement, would underbid SSA.

It has recently been proposed that determination of disability status, which is now done not by SSA directly but by the States, be privatized. GAO found that privatization of Disability Determination Services (DDS) would make the determination process less vulnerable to budgetary restrictions and hiring freezes, would improve Federal control and eliminate State political and governmental influences, and provide greater flexibility in selection of location and size of offices.[17] These functions would also probably cost less than alternatives (either the current arrangements, or complete federalization), if the productivity levels of the 10 most productive State DDS organizations were assumed to apply. However if the average State productivity now is assumed to apply, personnel costs would be $13 million higher than current costs.

In addition, GAO pointed to some disadvantages: the time necessary to get contracts planned, awarded, and operational, the possible loss of expertise developed by (current) DDS examiners, and possible disruption of claims processing during the changeover. Finally, GAO noted that there is a potential conflict of interest if a contractor also administers private disability plans tied to SSA determinations; and that it may be difficult to find competent contractors who are not already administering such plans. If more than one contractor were involved—for example, a different one for each State—there would inevitably be disparities in costs and quality of performance. Further, the necessity of recompeting the contract periodically would imply recurring periods of potential discontinuity, disruption, changes in procedures and very likely in quality, and investment in contractor learning and experience.

GAO did not, in this report, address the question of whether the level of competition for such contracts would be adequate to assure high performance and achievement of other congressional objectives, although the GAO report did ask, but did not attempt to answer: "Are there enough private entities able to process the disability cases?" GAO also raised but did not discuss the significant policy question: "Should a major federal program with a very complicated process and the obligation to pay about $23.5 billion a year in benefits, be operated by the private sector?"

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[17] See U.S. Congress, General Accounting Office, *Current Status of the Federal/State Arrangement for Administering the Social Security Disability Programs*, Report to the Honorable Jim Sasser, U.S. Senate, HRD-85-71, Sept. 30, 1985. In establishing the Disability Insurance Program, in 1954, and the Supplemental Security Income Program, in 1972, Congress provided that the States should make determinations related to disability (Disability Determination Services, or DDS). There has always been great variability among the States in terms of rates of accuracy, medical consultative examination procedures, physician participation, employee standards and salaries, etc. During the initiative to purge disability rolls (described above, also see ch.7), some States refused to cooperate. The Social Security Act of 1980 strengthened SSA control and oversight of DDS. There have subsequently been proposals both to fully federalize it and to privatize it.

These issues argue that the question of whether SSA operations should remain in the public service or be contracted out should be seen as a matter of social policy, rather than as a narrow question of competitive bids and cost-effectiveness.

SSA AND THE PUBLIC: ISSUES OF DATA PRIVACY AND SECURITY

SMP has not yet had a direct effect on privacy or on freedom of information, but it raises many issues for the immediate future, and exacerbates some older issues. Congress and the Administration are currently emphasizing the efficient collection and sharing of information to reduce fraud and waste. SSA accordingly is participating in many data-sharing and computer-matching programs. It is anticipated that SMP, when implemented, will affect these programs by: 1) increasing their number, by making them easier or less costly; 2) encouraging their use for front-end verification (that is, original determinations of eligibility for benefits programs); and 3) facilitating the electronic exchange of information, including "hits" or successful matches, over long-distance wires, cables, or satellite transmissions. Civil libertarians are concerned because data-sharing and computer-matching capabilities increase the opportunities for inadvertent or deliberate violations of privacy, and could be misused for government surveillance of individuals.

Throughout its history, SSA has had an excellent record of respect and care for the privacy of its clients. Recently, however, the increased emphasis on reduction of fraud and improved debt collection sometimes comes into conflict with the letter or the intent of legislation designed to protect the privacy of citizens. For example, the privacy of tax information is protected by the Internal Revenue Code, Section 6103, 26 U.S.C., which permits disclosure only by consent of the individual, and clearly spells out the meaning of consent as "voluntary action." The following notice, taken from an SSI application form, peremptorily demands from the client tax information to be used in making Supplemental Security Income benefit determinations:

> **You have a choice about signing this form. But we must have accurate information about your income and what you own to pay your Supplemental Security Income Check. If you do not sign the form, your Supplemental Security Income Checks may be affected.**

The provision of this information, under the implied duress, is of greater concern to civil libertarians because of the data-sharing and computer-matching activities described below, which means that the information (and errors that it might include) can become widely disseminated, through channels and to destinations that the citizen does not even know about.

New Information Policy Directives for the SSA

During the 1970s three major themes governed Federal information policy: defining the privacy rights of individuals, defining rights to government information, and defining the rights of individuals to access to and participation in government decisionmaking through eight major pieces of legislation.[18]

The information policy legislation of the 1980s is concerned with different concerns and subjects: reduction of fraud in Federal programs, efficient management of information resources, and reduction of debt owed to government by releasing information to debt collection agencies.

The computer-matching activities of SSA, and the continual sharing of SSA data with other Federal agencies and with State agencies, reflects these new priorities. These procedures are a departure in spirit if not in law or administrative procedure from SSA's traditional policies regarding personal data, set out first in 1935, as described in chapter 5. While these traditional rules allowed data-sharing under some circumstances at the agency's "discretion," SSA historically did so only rarely and with reluctance until recent years.[19]

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[18] Fair Credit Reporting Act of 1970, Crime Control Act of 1973, Family Educational Rights and Privacy Act of 1974, The Privacy Act of 1974, Tax Reform Act of 1978, Protection of Pupil Rights Act of 1978, Privacy Protection Act of 1980, Electronic Funds Transfer Act of 1980.

The Privacy Act included an ambiguous provision that agencies should share information only for a purpose compatible with the purpose for which it was originally collected—the "routine use clause." The implied limitation against sharing data was never seriously enforced by OMB.

In the 1970s, GAO reports tended to reflect congressional concerns with invasion of privacy; by the mid-1980s GAO reports encourage the sharing of information among government programs at Federal, State, and local levels in order to reduce fraud, waste, and costs. Six major GAO reports recommended use of computer-matching and tax return information to reduce fraud and abuse in Federal entitlement and benefits programs (these reports did not focus exclusively or directly on SSA).[20] The sharing of information among agencies was encouraged by OMB's interpretation of the routine use clause as covering any use published in the *Federal Register*. The President's Council on Integrity and Efficiency (PCIE) and the Grace Commission were established in 1980 to assure that Federal agencies use modern business methods to reduce costs. PCIE was, in particular, designed to increase the use of government computer matching programs.

These new initiatives have put pressure on SSA to engage in aggressive debt collection practices, and caused SSA to move strongly to establish a Federal parent locator system and a series of data exchanges with other Federal and State programs.

Concerns about privacy, confidentiality, and freedom of information are likely to grow in the next 5 years, although at present they are overshadowed by concerns about efficiency and productivity, with a resulting emphasis on sharing of Federal data. Legislative proposals to protect due process rights of individuals who are the subject of Federal computer-matching programs and related programs are nevertheless a possibility, within the next 5 years. The need for security, data quality control, and system integrity will continue to grow, and may well be made more acute by the threat of political terrorism. New legislation in this area is possible, especially if there are significant lapses in security or discoveries of fraud.

The major thrust of information policy in the near future, however, may be additional requirements for SSA to share information with other Federal, State, and local agencies. Active political support in both parties for maximizing government use of information will put additional demands on SSA information systems.

SSA's Data-Sharing Programs

SSA has important reporting and data exchange relationships with States and localities, other Federal programs and institutions, and private insurers (through its continued administration of Medicaid/Medicare). These relationships are a function of policy and statutorily defined programs. SSA's major data-sharing relationships are:

- *The Beneficiary and Earning Data Exchange (BENDEX)*, created in 1968 to provide Title 2 information to States for administration of the AFDC programs. This is a monthly batch system with transmissions occurring at the request of specific States (not all States are members of the system). There are on average 3 million inquiries per month.

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[19] Many Federal agencies have felt the pressure for increased sharing of data and lessened emphasis on privacy and security concerns; but for a contrasting viewpoint, see Sherry Courtland, "Census Confidentiality, Then and Now," *Government Information Quarterly* 2:4, 1985, pp. 407-418.

[20] U.S. Congress, General Accounting Office, *Federal Information Systems Remain Highly Vulnerable to Fraudulent, Wasteful, Abusive, and Illegal Practices*, NASAD-82-18, April 1982; *Actions Needed To Reduce, Account for, and Collect Overpayments to Federal Retirees*, AFMD-83-29, June 1983; *Computer Matches Identify Potential Unemployment Benefit Overpayment*, GGD-83-99, August 1983; *GAO Observations on the Use of Tax Return Information for Verification in Entitlement Programs*, HRD-84-72, June 1984; *Better Wage-Matching Systems and Procedures Would Enhance Food Stamp Program Integrity*, RCED-84-112, September 1984; and *Eligibility Verification and Privacy in Federal Benefit Programs: A Delicate Balance*, HRD-85-22, March 1985.

- *The State Data Exchange* (SDX), developed in 1974 at the time of implementation of Title 16 (the Supplemental Security Income Program), to advise States of the amount of SSI payments, eligibility for Medicaid, and other information to assist in administration of income, health, and food programs. Data is exchanged (usually by magnetic tape) weekly or monthly depending on agreements with a State. There are about 2 million exchanges per month.
- *The State Income and Eligibility Verification System (SIEVS).* The Deficit Reduction Act of 1984 required the States to develop a verification system for administering federally assisted programs such as unemployment insurance, food stamps, Medicaid, and AFDC. SSA will provide data to the SIEVS from SDX and BENDEX and will respond to State requests for assistance. SIEVS will also be used in social security number verification. SSA in turn will be able to receive information from the States to aid in administration of SSA programs and avoid overpayments.
- *The Tennessee Data Exchange (Model Program).* This is a pilot on-line data exchange between a Tennessee State welfare agency and SSA; it was designed to speed the provision of SSA data to the State for eligibility determinations.

The upgrade of the SSA systems so far has substantially increased the ability to respond to batch requests from State agencies. Whether in the future SSA's capacity will be sufficient to support on-line response to State agency inquiries is still uncertain. The SIEV program in particular will place an additional workload on SSA; when fully implemented, SMP will increase SSA's efficiency in meeting the requirements of this system.

SSA's Computer-Matching Activities

In modern society, most persons leave a trail of transactions with various institutions—governmental, retail, financial, educational, professional, criminal justice, and others—as discussed in a recent OTA report on surveillance.[21] Before the widespread use of computer-communication systems, linking various kinds of transactions was very difficult, if not impossible, since transactions were paper based and the cost of matching or linking paper records was prohibitive. In addition, the time delay inherent in paper linkages would negate much of the potential surveillance value. The advent of large fully computerized, easily accessible databases, and the ability to exchange and compare data between them, creates a much larger risk of violations of privacy. At present, some government uses of data for purposes other than those for which they were collected, albeit for legitimate government functions of law enforcement and investigation, are being challenged.

Because SSA collects, stores, and uses a large amount of data about individuals—earnings and income, employment records, dependents, home and work addresses, etc.—and matches these data with data about the same individuals from other sources (e.g., State prison systems and welfare agencies), its policies and procedures with regard to individual privacy are of special concern.

Computer-matching is a technique whereby a computer compares two databases to identify overlaps, e.g., individuals for whom both databases have records. The rolls of recipients under one public assistance program, for example, may be matched with the rolls of another such benefits program to identify people who are getting multiple benefits. Both databases may include several kinds of information about the person; the match will or can aggregate this information, thus potentially allowing the user to know or deduce a great deal about the subject person. Although the purposes of computer-matching are generally legitimate and justifiable, it also opens the door for misuses of such personal information by government, or by persons who have access to the information and may use it for unauthorized purposes.

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[21] Privacy, security, and surveillance issues are a primary focus of a series of OTA assessments known collectively as the Federal Government Information Technology Assessments. Three reports from this study have been published: *Electronic Surveillance and Civil Liberties*, October 1985; *Menagement, Security, and Congressional Oversight*, February 1986; and *Electronic Record Systems and Individual Privacy*, June 1986. The next few paragraphs draw liberally on these reports, and on responses to a Federal Agency Data Request which was sent out to assist the OTA staff in collecting information for use in these assessments.

There are several questions to be asked about such programs, in addition to the broad issue of whether they are inherently an unjustifiable intrusion on privacy or an unacceptable risk to civil liberties. These include:

- How are computer-matching programs authorized and who is responsible for their use?
- Is the data used strictly and solely for the purpose for which it was collected, as required under the Privacy Act?
- Are these activities cost-effective?
- What assurance is there that the matches, or "hits," are valid, that is, accurate and verifiable?
- What safeguards does the individual have against incorrect "matches" that penalize him or her in some way?

SSA makes liberal use of computer-matching techniques. These matching programs are not specifically mandated by law, but are often recommended to SSA by GAO to increase the accuracy of its determinations of eligibility and benefits amounts. In other cases SSA allows its data to be used by other agencies—Federal or State—for their own purposes. Table 2 shows the major computer-matching programs.

SSA computer-matching is undertaken under OMB guidelines and the conditions are spelled out in written agreements with the cooperating (matching) Federal or State agency. When SSA allows other Federal or State agencies to use its data for matching, these agreements typically contain a set of safeguards: the files that are used remain the property of SSA and must be returned or destroyed, as appropriate, after use; they may not be duplicated or disseminated without written permission; they must not be used to extract information about "nonhit individuals" (i.e., those who appear only on SSA records); they must be used only by authorized employees under supervision, and those users must be explicitly informed about Privacy Act requirements and OMB guidelines as to protection of privacy.

As can be seen in table 2, SSA generally uses computer-matching to verify the status of claimants or their dependents with regard to benefits programs or to determine whether an individual is collecting a paycheck or another form of assistance. For example, is a beneficiary's surviving dependent in full-time attendance at a legitimate school or university, in order to qualify for students' benefits? Is a recipient of disability benefits in prison (in which case benefits are suspended)? Under a pilot program, SSA is matching data with State agencies about interest payments from financial institutions, to assess individuals' income and resources, for use in Supplemental Security Income determinations. SSA data, conversely, is shared with several Federal and State agencies, including IRS, the Veterans Administration, and the State of California.

SSA does not, as yet, use computer-matching in the original determination of eligibility for a program for new applicants ("front-end verification"). It may do so in the future; no decision on this point has been reached as yet.

The computer-matching programs, it can be argued, are a significant departure from the spirit if not the letter of SSA's famed Regulation No.1, issued in 1935, which expressed the agency's commitment to safeguarding the confidentiality of personal data (see ch. 5). There have, however, been no court challenges to SSA on the grounds of privacy in computer-matching.

SSA has not done any formal cost-benefit analysis of the computer-matching programs, either before or after the matching is run. However, there is usually a pilot run, which gives

Table 2.—SSA Computer-Matching Activities

SSA data matched for SSA purposes:
(continuing, annually, unless otherwise indicated)

Agency matched with	Type of data	For SSA determination
U.S. Department of Education	Full-time attendance status	Eligibility for student benefits
U.S. Department of Education	Student marital status	Continuing benefits
U.S. Department of Defense	Military payments	SSI overpayments[a]
U.S. Office of Personnel Management	OPM payments	SSI computation[b]
Railroad Retirement Board	RRB payments	SSI computation
U.S. Veterans Administration	VA payments	SSI computation[c]
Various State and Federal agencies	Workers' compensation, State pensions, AFDC, general assistance benefits	Benefit computation[d]
Federal and State prison systems	List of felons	Precluding payments of benefits (Public Law 96-473)[a]
U.S. Office of Personnel Management	OPM payments	Prevention of overpayments[b]
U.S. Department of Labor	Black Lung reports	Overpayment of Part C Black Lung benefits[a]
Various State agencies	Annual interest income from financial institutions	Overpayments from underreporting of income/resources (pilot)[a]
State and Federal agencies	Workers' compensation	Overpayments (pilot)[a]
U.S. Internal Revenue Service	Income data	Overpayments because of unreported income/resources

SSA data matched by other institutions for their purposes:

User agency	Data	Agency's purpose
U.S. General Services Administration	SSA master files	Social Security number validation[e]
U.S. Internal Revenue Service	SSA data	Administration of Elderly Tax Credit[a]
State of California	SSA data	Eligibility for Medicaid benefits[e]
U.S. Veterans Administration	SSA data	VA offset of SSA Black Lung payments[f]

[a] As needed.
[b] Twice a year.
[c] Three times a year.
[d] Quarterly.
[e] One time.
[f] Monthly.

SOURCE: Office of Technology Assessment, 1986.

some indication of whether the matching will be productive, and there is a calculation of systems costs in running a program. The agency says that in preparation for expanded computer-matching when its systems modernization has progressed further, procedures are being developed for systematic prerun and postrun cost-benefit analysis.

Some individuals do lose their benefits, or have them reduced, as a result of computer-matching; otherwise there would be no benefit to the agency (and OMB) in using the technique. SSA goes to some length to verify "hits"; they are checked against the original data on SSA's tapes or disks, and the subject individual, who has not of course given consent to or been notified of the matching procedure, is given an opportunity to challenge and refute the results.

Benefits that an individual may "lose" as a result of these computer-matching activities are (assuming that the information is accurate) unlawful benefits, that is, benefits to which he or she was not entitled. The real concern of civil libertarians is the possibility that such techniques, and the databases on which they operate, might be used for other purposes, such as surveillance.

Future Information Systems and Possibilities for Abuse

In 1985, OTA issued a report on the use of computer and telecommunication technology by the Federal Government for surveillance and monitoring of individual behavior.[22] The report said that many new and emerging electronic technologies can be used for monitoring individual behavior, and the use of other electronic technology, such as telecommunication systems, can be easily monitored or recorded for investigative, competitive, or personal reasons. The existing statutory framework and judicial interpetations, OTA pointed out, do not adequately cover new electronic surveillance applications; the law has not kept pace with technological change.

The basic public law for protection of oral and wire communications is Title III of the Omnibus Crime Control and Safe Streets Act of 1968, which predates most of these technologies. Digital communications between computers is not covered by existing statutes, and policy on database surveillance—the monitoring of transactions on computerized record systems and data communication linkages is not clear. The courts have on several occasions noted that the law has not kept pace with these technological changes. Congress in legislating in this area attempts to strike a balance between civil liberties and the needs of domestic law enforcement and various investigative functions of government.

The technologies that OTA considered include for example, satellite communication systems, digital switching and transmission technology, computer databases, electronic mail, and integrated services digital networks, many of which SSA uses or will be using. Others are less likely to be of use to SSA, although their use at some time in the future is possible.[23] SSA expects to use, but does not now use, teleconferencing, expert systems, voice mail, and optical disks. There are pilot projects now underway to explore some of these techniques. SMP does offer the potential, in the future, of giving people access to their own SSA records through home computers. SSA is not planning for this but several States are considering such plans with selected State record systems.

SSA is not an enforcement or investigative agency, but it is responsible for certain functions such as entitlement determination and debt collection, that could involve surveillance, as well as for safeguarding its data and its transactions, which involves monitoring the use of its equipment and the behavior of its employees. Much sensitive SSA data will flow over leased lines between headquarters and interactive terminals in field offices when the new claims modernization project becomes operable. Satellite communication links are also possible. The new systems that SSA plans to develop to assure the integrity and confidentiality of its data are not yet fully developed.

Security of SSA Systems

Data in computers and telecommunication systems are vulnerable not only to misuse but to inadvertent loss through systems failure, to theft, or to manipulation or destruction through sabotage or terrorism. The security of information systems against internal or external violations is of primary importance.

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[22] U.S. Congress, Office of Technology Assessment, *Electronic Surveillance and Civil Liberties* (Washington, DC: U.S. Government Printing Office, October 1985).

[23] Electronic eavesdropping technology, optical/imaging technology for visual surveillance, sensor technology, civilian band radios and vehicle location systems, polygraphs, voice stress analyzers, voice recognition, laser interception, and cellular radio.

The security procedures at SSA's National Computer Center are those common at most large ADP centers. Physical security for the facility and for separate rooms and floors is thorough; and data security is safeguarded with standard techniques of personnel screening, restrictions on dial-up access, passwords, and audit trails. Backup battery power and generators are available to keep the computers going for 3 days in case of power outages. SSA says that all records are backed up.

The DHHS Inspector General warned SSA in early 1984 that:

> SSA is not prepared for a disaster in the NCC. . . . SSA's ADP systems are highly centralized in its NCC and operate without adequate backup in the event of critical damage, or worse—a catastrophe. Although there have been attempts made to plan for contingencies, efforts to date have been inadequate. Further, offsite backup of data and software is incomplete and untested.[24]

The audit report said that responsibility for contingency planning had not been focused at a high level, SSA had not performed necessary risk analyses, and SSA components "whose expertise is necessary to develop a workable plan" had not contributed to the effort. Subsequently SSA agreed to establish a new security planning work group and assign greater importance to contingency planning. A risk analysis study for the National Computer Center had been done in 1982; but subsequently there have been several additional contractor studies of risk as well as top secret access procedures and audit controls.

None of these security measures apply to the use of microcomputers, outside of the National Computer Center, for example in headquarters and operations buildings, and there are no established security policy or procedures for microcomputer users. While the integrity of data is fairly well assured, privacy may not be. As interactive terminals and personal computers are added to field offices, these concerns will become pressing. Access controls are being reviewed and revised as part of SMP, but this work is not complete.

There have been a number of cases of internal sabotage and computer-related crime at SSA, as is perhaps inevitable.[25] SSA says, however, that no known instances of computer crime involved data processors; they occurred earlier in the work process. A typical case is a field office employee inventing a fictitious claimant, or altering information about a beneficiary or a payment amount.

SSA has long been criticized for having inadequate safeguards against unauthorized access to its data. Specifically, it has lacked programmer security controls, internal access controls, and audit trails. Though no computer programmer at SSA has ever been found guilty of fraud against the agency, it has been quite possible for programmers to make changes to pay themselves benefits; unauthorized people could log onto systems; data review technicians in District Offices could enter claims for themselves without leaving an audit trail.

The SMP will: create an audit trail for computer program changes, assign personal identification numbers to claims representatives and local workers, create an audit trail for all transactions, and employ a central security systems package like those used by the military to handle log-on commands and records. However the very rationalization of SSA procedures and the existence of schematics and diagrams mapping the system, pose a threat to security that does not exist now, in that more people may be able to discover how to get into the databases.

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[24] U.S. Department of Health and Human Services, Office of Inspector General, Memorandum to Martha A. McSteen, Acting Commissioner of Social Security, "Audit Report—SSA's Planning for Contingencies in the New Computer Center," ACN 15-42624, Mar. 22, 1984.

[25] In the 4 years before the SMP began, there were at least 46 known cases of vandalism inside secure data-processing areas, and former SSA officials told Congress of other threats of sabotage that had been received. See U.S. Congress, *Mismanagement of SSA's Computer Systems Threatens Social Security Programs*, 33d Report by the House Committee on Government Operations, Sept. 30, 1982, p. 9. The SSA response to OTA's Federal Agency Data Request acknowledged some (presumably recent) "known instances of crime and abuse" but specified that they did not involve data-processing people.

Chapter 4

The Future: The Necessity of Long-Range Technology Planning

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Chapter 4

The Future: The Necessity of Long-Range Technology Planning

The Social Security Administration badly needs well-developed and effective long-range planning capability. The Systems Modernization Plan deals primarily with technology, and secondarily with technology management. It will be most effective if it is implemented and extended in the context of an institutional long-range plan that provides insight about how the agency's mission will change over time, alternative ways of performing that mission, the resources that will be available, and the capabilities that will be needed.

Technology is an essential element in SSA's future. But technological forecasting and assessment, even if greatly improved at SSA, will not constitute a long-range planning capability. Factors other than technology will influence the organization's future, such as changes in its mission, resources, and relationships with other institutions; and these factors shape the purposes and goals for the technological systems. Some of these factors are within SSA's control, and some are not; but continuing monitoring and analyzing of such factors can allow the agency to be prepared for changes and make a smooth transition to new ways of fulfilling its mission.

ELEMENTS IN SSA's FUTURE

SSA's Mission

SSA's basic mission is unlikely to change significantly over the next decades. There will almost certainly be congressionally mandated changes in coverage, entitlement provisions, benefits, etc. Some of the programs now administered by SSA could be removed, or other responsibilities added, with additional requirements for data collection and handling. New social programs that might be assigned to SSA, however, usually have long gestation periods, and the assignment can be anticipated by agency planners.

SSA's mission therefore is, and is likely to remain, more stable, coherent, and routinized than that of many government agencies. This is a significant advantage for long-range planning.

The objective for planners, in this situation, is to help the agency define its goals and priorities in carrying out its mission, and to help it set reasonable standards of performance in terms of quality, timeliness, and costs of service delivery. At present, the agency is unable to respond with credibility to either the Office of Management and Budget, Congress, its employees, or its critics on questions related to the realization of productivity gains, the most manageable rate of work force reduction, and the appropriate timing of further procurements, largely because it has not explicitly defined its goals and milestones in a way that can be credibly justified. Looking beyond the next 5 years, a long-range plan should provide alternative technological and institutional mechanisms for service delivery in the context of evolving needs of the clients and future capabilities and costs of information systems.

The functions essential to carrying out SSA's mission involve:

- data collection;
- data processing;
- data protection (privacy and security);
- service delivery;
- accountability and information dissemination (providing information needed by the Administration, Congress, and the public); and

- coordination with other Federal and State agencies.

Each of these is subject to change. New kinds of data may have to be collected, new services may be mandated, law and public policy may set new standards for data protection and accountability, and new technology will change both the available techniques for and the costs of performing all of these functions.

The Placement and Structure of the Agency

SSA might at some time be separated from the Department of Health and Human Services and be given the status of an independent agency. The most important changes in management and reporting responsibility would in this case be mandated by law. The most likely structure of agency leadership is already apparent from legislative proposals before Congress, and should therefore not take the agency by surprise.

Internal reorganizations are a more immediate and more likely possibility, and have significant implications for long-range planning. Information systems development and planning to be most effective must reflect and support the flow of work--i.e., the movement of information and the sequencing of steps in its processing—through the organization. A long-range planning process that enabled the agency to define its goals and priorities could provide a valuable guide to organizing the agency for greatest effectiveness. It would allow the phasing in of desirable changes in a logical and orderly manner, providing at the same time a rationale and justification for the changes to managers and workers. Conversely, the relationship between programs (OASI, SSI, etc.), between operations and systems development components, and between field offices, Regional Commissioners Offices, Program Services Centers, the National Computer Center, and headquarters staff, should be considered in establishing a planning unit and determining its responsibility, location, role, and reporting processes.

Staff Changes

This may be the most immediately challenging and least adequately considered element in SSA's future. Technological change, congressional budgetary decisions, and Administration policies are pressing toward significant changes in SSA's work force, but the agency is responding in a largely reactive rather than proactive mode. A rational and persuasive plan for reconciling and mediating these pressures could allow the agency to shape and influence decisions that will finally be made or sanctioned outside the agency.

The groundwork was laid for an innovative approach toward cooperative labor-management adjustments to change, but there are indications that this promising start is being allowed to wither. Unresolved questions involve recruitment, training, job classification, compensation adjustments, promotion, relocation, working conditions, labor-management relations, and retirement policies. All apply to managers, professional staff, and clerical staff, but there are different needs and constraints for each group. These needs and constraints are intimately related to changes in technology, and to Administration policies, the two factors with which long-range planning will be primarily concerned.

Clients

While SSA's mission is basically simple and stable, there will be changes in the demographic makeup of its clients over the next two decades, which will or should affect the way in which the mission is performed and the criteria for excellence in performance. For example, the age distribution, educational level, ethnicity, language problems, technological sophistication, and family resources of beneficiaries and their survivors may change significantly. Some of the problems which occurred with implementation of the SSI program illustrated the way in which changes in client needs and expectations determine the effectiveness of traditional SSA procedures.

TRENDS IN INFORMATION TECHNOLOGY

Table 3.—New and Potential Technology for SSA Functions

Function	Technology
Communications	Local area networks
	Electronic mail
	Private branch exchanges
	Digital switching and transmission
	Fiber optics
	Communications satellites
	Cellular mobile radio
	Data encryption
	Integrated Services Digital Networks (ISDN)
	Voice mail
	Teleconferencing
	Two-way cable
Data collection	Home computers
	Client-operated devices (similar to ATMs)
Data input	Optical character recognition
	Voice recognition
Data output and presentation	Computer graphics
	Voice synthesizers
Data processing	Minicomputers
	Relational databases
	Query-by-Example
	Multi-use super-micros, application software packages
	Supercomputers: multiple instruction multiple data (MIMD) processors, vector processors, data driven processors, FORTRAN programs
	Parallel processing
	Associative processors
Entitlement evaluation, adjudication	Spreadsheet applications
	Expert systems
Storage	Magnetic bubble devices
	Wafer-scale semiconductors
	Optical disks
	Smart Card

SOURCE: Office of Technology Assessment, 1986

New advances in information technologies and related management tools, beyond those envisaged in SSA's 5-year Systems Modernization Plan, are available now or are reasonably certain of becoming available in the near term, and can be rationally anticipated and planned for (see table 3). They will be the standards by which experts will evaluate SSA systems and management in the 1990s. Unless SSA begins now to systematically prepare for modernization beyond a 5-year horizon, it may again find itself falling far behind the "state-of-the-art" at which SMP is aimed.

SSA has historically emphasized heavy-duty computing needs of the core administrative functions—the processing of enumeration, earnings, and the master beneficiary file. Other uses for computing will be increasingly important.

Some new developments in information technology will be useful chiefly for advanced scientific research, at least in the near future, but such capabilities are generally soon adapted to the more prosaic operations of corporate and government institutions. Monitoring these developments and trends as they emerge will be necessary if SSA is to plan to use new technical capabilities when they become reliable and cost-effective.

Other technical capabilities are already available and in use in leading private sector organizations and in some government agencies. Some of these do not, however, yet appear in SSA's Systems Modernization Plan, or are only incorporated as eventual enhancements rather than as pivotal points of leverage for making optimum use of information systems.

For example, to use information technology to the fullest in improving its management of operations, SSA will need to develop more powerful administrative processing and management information systems, designed to access transactions information and manipulate it to answer managers' questions. These management information systems could also aid Congress in oversight of SSA, although as pointed out above, they could also be used, unfortunately, to select and present only favorable indicators and benchmarks.

Software Trends

Software development has historically lagged behind hardware development, but it is now a major focus of information science research and development in the United States and in other nations, and can be expected to move rapidly over the next decade. Major trends in software that could be better utilized by SSA are:

- *Enhancements to Systems Analysis and Design*: These tools, called "interactive requirements analysis tools," are designed to codify data, reduce errors, and improve the documentation required when establishing the requirements for a large information system. They fall into the larger family of tools called "structured analysis, design, and programming techniques." New ones use forms-based systems to achieve uniformity of documentation and design, by prompting the designer with questions and blanks. They improve compliance with programming and design standards, which has been one of SSA's problems. Others help the systems analyst to put the systems design in a particular format or notation that can be fed into a code generator for key parts of a computer program. These software design tools can in the future be incorporated into larger automated design tools.
- *Code Generators*: These are computer programs that assist programmers in quickly producing third-generation language programs, for example, COBOL programs. One is Quick-Code, which generates DBase II programs; others are Quick-Pro, the Producer, and Genasys. Some reports have shown productivity gains approaching 75 percent with the use of these code generators.
- *Development of Fourth-Generation Languages*: These are computer languages that use English-like vocabulary and syntax, and are useful for the development of administrative and management information systems. The distinction between fourth-generation languages and database management (software) systems is in fact becoming ambiguous, and often depends in part more on who will be using them (systems developers or systems end-users), than what they can do. For programmers, these computer languages can produce order-of-magnitude increases in productivity; it is estimated that most fourth-generation languages result in 10 times greater productivity than COBOL. Most of these languages are not yet capable of being used for sophisticated applications but they are likely to be so in the future. In the area of management information systems, they are now capable of providing responses to most kinds of questions needed for reports. Examples are FOCUS, RAMIS, SQL.
- *Relational Databases*: These database structures (ways of organizing data) permit great flexibility in the ways of asking for information, and they use English-like fourth-generation languages in addition to being compatible with COBOL and other third-generation languages. Examples are Univac's Mapper, Culinet's IDMS, and IBM's DBase-II. Relational databases are now a small but rapidly growing portion of the data storage and retrieval market. For high-volume applications they are still too slow; as of yet they cannot be used with very large, heterogeneous databases with many thousands of records, but very powerful computers may in the future enable SSA to take advantage of them.

Developing and maintaining software is now the dominant cost of creating and operating large computer systems. Advances in microelectronics have steadily reduced the cost and improved the performance of hardware, but improvements in the productivity of programmers has been much more difficult to achieve. Software engineering, techniques for improving the productivity of programmers and designers, is increasingly important. Research in this field includes highly theoretical work directed at fundamental understanding of the nature of programs and "proof," in some mathematical sense, that they will work as intended. At the other end of the spectrum, it includes behavioral science research on the ways in which people interact with computers (the "man-machine interface") and techniques for management of programming tasks.

Artificial intelligence is a field of research concerned with extending the ability of the computer to more nearly match human mental capabilities, such as recognizing and understanding speech and visual images, reasoning, choosing among options, or deciding, and spontaneously communicating. The first significant commercial applications of artificial intelligence, after at least 25 years of research, are in the area of expert systems. These are "intelligent" information retrieval systems designed for use in tasks requiring expert knowledge, such as insurance underwriting, medical diagnosis, weapons control, or business decisionmaking. Expert systems store not only data, but rules of inference that describe how an expert would use the data to make decisions. The expert systems' rules of inference are derived from analysis of the decisions of many experts, and can therefore make a user's decisions more comprehensive, more rigorous, and more consistent than those of a typical user who is not in the top echelon of experts in the field, and at least in theory better than the decisions of any one expert might be. Since insurance underwriters are already using expert systems, applications for SSA claims representatives, or State determiners of disability, are an obvious possibility to be explored.

Hardware Trends

In order to run sophisticated languages and relational databases, faster and cheaper machines with new capabilities are needed. The faster and cheaper the machines become, the easier and more economical it is to use languages which are less efficient but more suitable for use by nonspecialists. The following developments should be helpful for SSA:

- *Database Machines*: In order to operate relational databases at reasonable speed, it is necessary to use parallel processing, so that several operations can be done at once. A database machine is several orders of magnitude faster than other machines; some are on the market that can execute 10 million instructions per second and speed up database transaction processing 10 to 20 times, reducing the cost of these operations.
- *Increased Power*: It is likely that in the next 5 years the cost per unit of computing power will continue to decrease and the speed increase, as they have in the recent past. Supercomputers—or advanced architecture and parallel processing—may become available to very large organizations like SSA; allowing processing at much higher speed and much lower unit cost. The need for sophisticated cost-effectiveness comparisons of systems in the future will be of increasing importance.
- *Mass Storage Technology*: Magnetic disk storage technology continues to improve in capacity and cost, but laser optical disk technology offers storage of up to 2.5 billion bytes on one 12-inch disk, several orders of magnitude more density than possible on a magnetic disk. There are still a number of technical problems related to the use of optical disks for organizations with immense databases like SSA's; for example, improved computer-controlled indexing systems are needed, and there are unanswered questions about their archival "shelf life." Until very recently, optical disks could not be used in a read-write mode; since they could not be changed once data was recorded, they were useful only for permanent storage. Several firms are now working on erasable optical disks. Some commercial applications are available and others are nearly ready for market. Access time for erasable optical disk systems may continue to be a problem because of the enormous volume of data they can hold, but they clearly promise superior performance in comparison to existing sequential-access magnetic tape systems.
- *Communications*: SSA does not have much in the area of local area networks (LANs), PBXs, and wide-area networks (WANs) to link computers in buildings, cities, and counties. Failure to take advantage of these technologies will prevent it from developing efficient office automation and enhancing productivity in local district offices.

- *Optical Character Recognition Technology (OCR)*: OCR is now undergoing a spurt of rapid development. Typed or printed material can be read into the computer 40 to 50 times faster than it can be keyboarded. State-of-the-art OCR equipment can read up to 23 different fonts with an error rate smaller than that of an accomplished data-entry clerk, and some of the devices can also handle simple hand-printed notations, such as numerals. Within the next few years, OCR should have the capability to recognize, isolate, and read or copy specific bits of information within a larger volume of data.

New concepts of computer architecture now being explored in the laboratory will provide two waves of innovation: highly specialized, low-cost computer modules that do specific types of tasks at extremely high speeds, and future generations of supercomputers.[1]

Because computer hardware has in the past been expensive, users have tried to allocate its cost over a variety of applications and uses, with general-purpose mainframe computers. But as the costs of hardware drops, some computational tasks, involving high-volume standardized data, may in the future be done on inexpensive, special-purpose hardware with the general-purpose computer used as a routing switch, sending a computing task to one of several different specialized processors.

The term supercomputers is used for the most powerful computers available at any one time. The next generation of supercomputers is likely to have a radically different "architecture." Computer architecture is the internal structure of a computer, the arrangement of the functional elements that carry out calculations and manipulation of data. Since their invention, computers have basically followed one model, the von Neumann sequential processing architecture. The limits of computational speed that can be achieved with this design are being approached, and further increases in computer performance may require parallel processing architectures. That is, operations performed on the data would be decomposed into tasks that can be simultaneously carried out by many computational units working in parallel.

Very large-scale integrated (VLSI) circuit design facilities, using the most powerful computers, are being used to develop and test new architectural designs. Three U.S. companies (CRAY, Control Data Corp., and Denelcor) are developing "next generation" supercomputers, as are several Japanese companies. Japan has embarked on major supercomputer projects that may challenge U.S. leadership in supercomputers. One, called the Fifth Generation Computer Project, is aimed at producing a computer using artificial intelligence, or reasoning functions similar to human thinking processes.

Management Tools

SSA has adopted new software engineering techniques such as project management systems, automated documentation systems, report generators, screen editors, database management systems, etc. Already, however, some private sector organizations are moving from this software engineering technology approach to methodologies such as prototyping the end-user development (some of these new tools were described above under software trends). SSA should test and evaluate these newer technologies as soon as it has a database on which they can operate.

Federal agencies are required by the Paperwork Reduction Act to introduce information resource management (IRM) as a concept and organizational tool. This includes the creation of a data administration function and a data administrator's position at a high level in the organization. The concept of IRM is still controversial and poorly implemented in most Federal agencies and in private organizations. Nevertheless, it is important that SSA take a fresh look at the implications of this concept. It will need, for example, to put greater emphasis on development of organizational devices such as Information Centers, to help and support end-users.

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[1] Much of the material in this chapter is based on an earlier OTA report, *Information Technology R&D: Critical Trends and Issues*, OTA-CIT-268 (Washington, DC: U.S. Government Printing Office, February 1985).

If SSA is able to adopt new technologies, a large shift in data-processing skills will be required, from traditional complete reliance on COBOL programming toward greater capability to work with fourth-generation languages. There are vast differences in the skills required. There will be an increased need for database designers and administrators, code optimizers, structured analysts, prototypers, data communication network specialists, and decision support specialists. A large number of professionals will have to be recruited or retrained to produce the required labor force by the 1990s. Since many experts estimate that the stock of useful knowledge which a programmer has is depleted by one-half every 5 to 7 years, SSA's technical training programs will be increasingly critical in terms of upgrading technical knowledge on a continuing basis.

SSA's CONTINUING UNCERTAINTIES: DECISIONS ARE NECESSARY

SSA's response to its 1982 problems must be understood in terms of the technologies that were available. Much of the criticism of SSA's Systems Modernization Plan rests on the perception that SSA did not, in 1982, pay enough attention to the wide diversity of options available to it; and in the intervening 4 years it is not clear that SSA has developed an understanding of the rapidly developing and diversifying technological options that it will have in the future.

By 1982, it was no longer necessary for an organization to arrange the entire computing function in a large, centralized, information systems department; machine intelligence could be distributed throughout the organization wherever needed. In addition, microcomputers, mainframes, minicomputers, and peripheral devices can be tied together with PBXs or LANs.

The 1980s is also a period of tumultuous change in the organization and marketing of telecommunication equipment and services. Many large organizations are bypassing local telephone companies by using their own fiber optic or microwave intracity telecommunication networks. The deregulation of the telecommunication market has led to an explosion of offerings of new telecommunication services, and rapid reduction in the price of both long-haul and local telecommunication costs. Managers must take more responsibility for making key decisions about protocols, organization, and maintenance, which heretofore the telephone companies had assumed.

By the 1980s, database technology has allowed a shift in thinking about data from "information as a cost" to "information as a resource." In the 1970s, information was usually highly fragmented among different levels of the organization, different specialized functions, and different computer programs. It was difficult for specialists in one division to share data with those in another division. Database management in the mid-1980s means:

- codification of data elements to define common meanings and to catalog origins and uses (a data dictionary);
- reorganization of data elements from thousands of computer files into a single pool or "database";
- separation of application programs from the data elements, by use of a database application development language; and
- reorganization of data elements to permit greater flexibility in responding to inquiries.

It must be recognized, however, as has been stressed throughout this report, that SSA's performance and problems are not greatly different from those of other organizations attempting to catch up with and stay abreast of broadening technological capabilities. The implementation of true corporate and govern-